December/January

The magazine for the serious Sinclair user

sinclair projects

SIX PROJECTS TO ENHANCE YOUR MACHINE

95p

Christmas lights
Eprom blower
Graphics generator
Joystick controller
Spectrum memory
Word processor

FIRST GREAT ISSUE

Plus latest news on the hardware market and tips on do-it-yourself techniques and the tools to use

sinclair projects

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FROM THE EDITOR

SINCLAIR PROJECTS is unlike any magazine on the market. It aims to cater for those who possess a Sinclair computer and are beginning to become disillusioned with playing Space Invaders and are convinced deep down that the computer is capable of much more.

Each issue of *Sinclair Projects* will present a number of graded projects designed for a spectrum of users from the absolute beginners to those who are highly competent at do-it-yourself electronics. We will also be printing a series of articles, teaching the complete novice how to choose a worthwhile set of tools and even how to solder.

The projects in the first issue start with a very simple board which will allow a range of applications to be covered in future issues. The first board to be plugged into this input/output card is a power controller, which will permit you to control anything from sets of Christmas tree lights—just to be topical—to train-set points to domestic lighting.

Yet another project will allow you to build a joystick controller for either the ZX-81 or Spectrum, thus allowing easy control of cursor position on the screen.

The two major projects in this issue—one software, one hardware—are really for those who know what they are doing. We take the EPROM blower project which won the competition recently in *Sinclair User* and describe how you can build it. The major software project looks at how you can use the Spectrum as a word processor.

Other pages in *Sinclair Projects* include a comprehensive round-up of new hardware plug-ins on the market and a look at some computer clubs which offer advice and help on building projects.

The next issue, in January, will consider some extensions of projects in this issue and will also bring you up-to-date with some of the new hardware releases which make their appearance at Christmas.

In common with most magazines in this field we welcome comments, criticism, ideas for future articles and even articles. We have appointed a group of technical assessors whose job is to evaluate each project as it is received to build it and test it so that we know it works before we publish it. If you have a project you would like to submit, please send it to the editor. Each project should cost less than £20 and use commonly-available components.

We wish you a merry Christmas—and get out those soldering irons.

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We've got big ideas about you and your Sinclair

Because we know you're always looking for new ideas to make the most of your Sinclair computer, we're making sure you never run out of steam!

Just announced – and due out in December – is **Sinclair Projects** magazine, full of fascinating schemes to tax your skills and reveal the **practical** potential of your Sinclair in applications like controlling lights, upgrading computer graphics, household security, and many more.

Whether you're new to computing, or an old hand, you're certain to be an enthusiast. That's why we introduced **Sinclair User** magazine for the latest news, techniques and enhancements to **match** your enthusiasm (now with new 'Spectrum User' supplement!) Next, its companion magazine, **Sinclair Programs**, became an overnight success with 40 NEW programs, ready for you to key, in every issue.

Now the exciting new Sinclair Projects completes your store of possibilities with a huge increase in computing potential for you to explore.

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Clubbing together for mutual support

THERE ARE more than 300 computer clubs in the U.K. That does not include the machine-specific groups like the national ZX Users' Group, which organises on a national basis. Most of the clubs are based on small groups of people, usually fewer than 100, who meet regularly in college rooms, libraries or even upstairs pub rooms.

If you have a computer, it is recommended that you join a local group as well as any national ones. In Club Spot each month we plan to look at some of the local clubs which cater for the typical reader.

Most clubs are good for those who know nothing about computers and want to pick a few brains before buying one, or for comparing new programs or even swapping them with like-minded users. What most do not cater for is the hobbyist interested in building bits and pieces to add on to their computers. The few who do will be the subject of this section.

The national group which co-ordinates the activities of all the local clubs and the majority of the national user groups is the ACC. It used to be called the Amateur Computer Club but a recent name change to ACC is an attempt to broaden its influence and take account of its new role.

The interests of the ACC are far-ranging and not tied to any one type of computer, microprocessor or manufacturer. It is consequently an ideal complement to the dedicated user groups which are formed for specific machines. It provides an insight into the many aspects of microcomputers which otherwise might be ignored.

Since its formation in 1972, the ACC has published a newsletter, now called *ACCumulator*. In the days when most people were scarcely aware of the giant mainframe computers, the ACC was the only computer club in the world and it can now claim to be the first computer club of all. *ACCumulator* was for five years the only magazine in Europe for the amateur and small business user.

With few commercially-made systems available, *ACCumulator* contained designs for complete computers, as do it yourself was the only way, and contained helpful articles for people building or repairing their systems.

That flavour of hardware designs and systems programming is maintained today, as the ACC is the only group catering for the so-called homebrew enthusiast. Yet the wealth of knowledge and expertise built from the early years has been vital for newcomers to computing and now *ACCumulator* reflects the changing scene, with information and comments on a selection of the latest machines to reach the market. In the last year low-cost designs have been published for a micromouse, four computers, an Epromulator, a programmable character generator, A/F and D/A converters, and a light pen.

> ACC has been a regular feature at computer shows for several years. Exhibitors regard it as the central contact for personal computer users.

The ACC is not limited only to a magazine. As membership grew, people joined to form local clubs and thus built the foundations of the now country-wide but still expanding network of groups. The ACC maintains a database of those groups and that is made available at exhibitions to keep people in touch with the activities in their areas. The database was also used by the BBC to form the basis of its Referral Service.

The ACC continues to provide help and service to the local groups, many of which have appointed an ACC representative—at a reduced subscription rate—to maintain close links directly with the committee. Also a reduced rate bulk subscription is available for clubs. They may then use *ACCumulator* to increase the size and diversity of their news sheets or relieve themselves entirely of that sometimes difficult task.

The ACC has been a regular feature at computer shows for several years. Exhibitors and national organisations regard it as the central contact for personal computer users.

The organisation advances with changes in technology and has held conferences on robotics and communications, formed a specialist robotics group, and maintains a number of news and information pages on Prestel.

The ACC is not a one-man band and is run by a committee elected democratically at the annual meeting. Run entirely by volunteers, the ACC remains the lowest-cost and best-value computer group, with a 1982 subscription of £5.

To join, send your name, address and subscription to The Membership Secretary, Rupert Steele, St John's College, Oxford, OX1 3JP.

NEWS

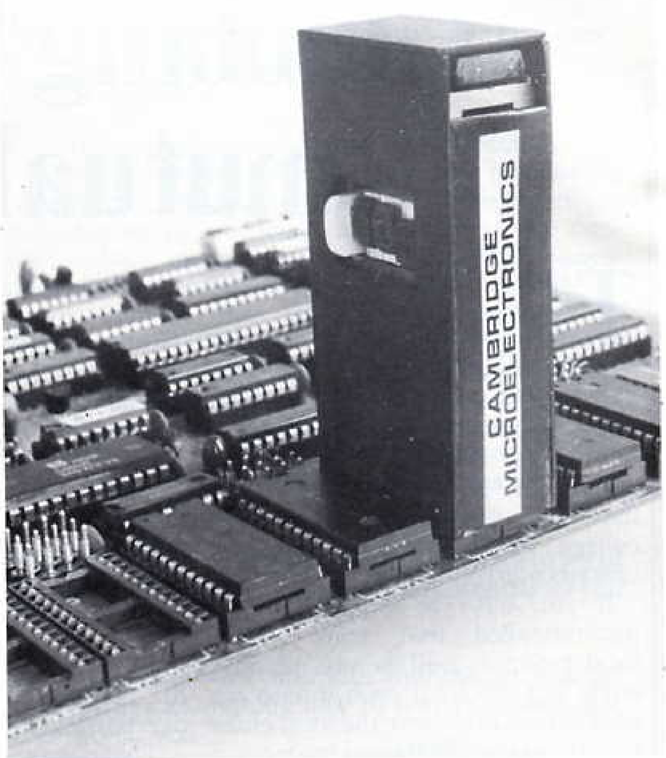
Data loss threat is overcome

THE CONSTANT threat of data loss on ZX machines has been overcome with a new device from Cambridge Microelectronics. It permits data to be stored on a computer for months without corruption or wipe-out.

The CMOS ROM/RAM unit, called Memtic T and produced by Camel Products, is a 2KB memory module with battery back-up. It resembles a tower block and fits neatly over a 24-pin IC socket. Three switches allow 1K or 2K read-write and power-down.

The lead provided may be used to write to the RAM, even when the device is plugged into a ROM socket. It can then be changed to the ROM mode or powered-down for several months of data storage, made possible by re-chargeable nickel cadmium batteries. The device uses fast access static CMOS RAM which makes it usable with almost any micro.

The Memtic T is produced as a ready-to-use unit and is available from Cambridge Microelectronics, 1 Milton Road, Cambridge CB4 1VY and costs £29.95.



The Memtic T.

Plug-in Spectrum amplifier

THERE ARE many amplifiers available for the tiny Spectrum speaker. The Spectrum Audio Amplifier is produced by Andrew Pennel and can be plugged straight into the Spectrum, where it can be used to hear the key depressions and the results of BEEP commands.

The amplifier uses the existing Spectrum power supply but puts a small additional load on it which is not harmful to the machine. The device does not block the expansion bus at the back of the Spectrum, so add-ons, such as joysticks for games, can be used easily.

The device has a volume control and socket which can be used to drive an external speaker for an extra loud output. The complete unit measures just 118 × 78 × 34 mm.

The Spectrum Audio Amplifier is complete with all necessary leads and full instructions and costs £9.95 inclusive. It is available from Andrew Pennel, 14 Sweyn Road, Cliftonville, Kent.

EPROM from Pilot

AN EPROM programmer ready for immediate use with the ZX-81 has been produced by Pilot Data. The device works using single 5V rail EPROM of types 2708, 2716, 2532 and their equivalents.

The circuit board is under full software control. The software is written mainly in machine code.

The programmer can be used to write, check, and edit listings. The programs can then be burned into the EPROM chip and verified to see if it has been entered correctly. The device can also read and copy from EPROM as well as saving EPROM program listings on cassette. New EPROMs can also be checked to make sure that they are clean and ready for use.

A power supply is provided for 5V and 25V rails and they use a ZIF socket.

The device is complete with instruction manual, power pack, and full software back-up on tape. The progammer costs £75.

Glaring problems eased

GLARE from televison and VDU screens can cause all kind of problems with a user's vision. A new anti-glare screen, called Video-Glasses, has been produced by File Binders Ltd.

The screen eliminates unwanted reflected light from the screen, it is claimed, while enhancing the clarity of the image. The sepia tint on the screen also eliminates screen flicker which can also be harmful to the eyes.

The Video-Glasses can be fitted in seconds and the frames are made especially to fit the user's terminal.

Further information from File Binders Ltd, 153-155 High Street, London SE20 7DS.

Colourful registers on market

TWO NEW registers are to be published listing suppliers of Spectrum products in the U.K. *The ZX Spectrum Guide* is from Youngs Computer Publications, which released the ZX-80/81 Register in 1982. The new Spectrum guide will include a list of software available, publications, hardware, and other items.

Youngs is considering compiling a supplement or new edition of the ZX-80/81 Register to bring that publication up-to-date and preparing supplementary editions on computer shops and domestic programs.

The guides will be available from Youngs Computer Publications, 2 Woodland, Gosfield, Halstead, Essex, CO9 1TH. The prices for the guides have not yet been decided.

The Guide to Spectrum Resources has been produced by the organisers of the Micro Scene Brum 82. It follows the *EZUG Directory of ZX Suppliers* which was published early in 1982 but it is a general guide and not related to its educational counterpart.

The Micro Scene guide will contain details of suppliers of Spectrum products, Spectrum books with reviews, software and hardware, and miscellaneous suppliers and services. The guide will be obtainable from Micro Scene, 6 Battenhall Road, Harborne, Birmingham, B17 9UD and will cost £2.50.

Spectrum speech pack

THE COMPANY which introduced Speech Packs for the ZX81, DCP Microdevelopments, has upgraded its products for use on the Spectrum. The Spectrum Speech Pack includes all the features found previously in the ZX-81 version, including ZX Connector, built-in speaker, volume control and expandable vocabulary. It is controlled by the Spectrum OUT command, followed by a number which indicates the word to be used.

The Speech Pack plugs directly into the rear of the Spectrum. The ordinary Spectrum power pack can be used with it and no extra equipment is needed. The ZX printer and other peripherals can be added on to the back of the unit.

The unit is accompanied by Word Pack ROM One which contains all the letters of the alphabet, numbers from zero to more than one million and other words and sounds. Three more plug-in ROM packs can be added to the speech pack at any time to expand the machine vocabulary to hundreds of words. The Spectrum Speech Pack costs £49.95 and additional word packs £14.95 each.

The Interspec is a new interface for the Spectrum. It adds on to the rear of the Spectrum and provides interfaces for such peripherals as joysticks or heat sensors. The device has four relay outputs for high current control, four switch inputs buffered for connection to contacts, and eight-bit input and output ports which can be used for home-built devices.

The Interspec unit includes the DCP bus, an expansion system using a 15-way connector which can control up to four more peripherals or, if a few additional components are added, up to 255 other devices. The unit is programmed using the IN and OUT commands of the Spectrum. It costs £39.95.

The DAC Pack plugs into the DCP bus of the Interspec. It contains an eight-bit digital-to-analogue converter with an output range of 0 to 2.55V. Other units compatible with the DCP bus can be connected to the DAC pack, which costs £14.95. All the devNorwich, NR13 4AX.

Dot matrix thermal printer

A NEW thermal printer for ZX computers which will rival that from Sinclair has reached the market. The SP40/42 thermal printer is a 40-column dot matrix printer which uses an Olivetti print mechanism.

Two models are available, providing print speeds of either two or four lines per second. They are both available as standard with a full 96-character ASCII set in upper- and lower-case, as well as graphics. They also have a large range of interfaces, with connectors fitted for most existing requirements.

Dean Electronics also introduced the Hi-Tek Dovetail keyboard. The design has been taken up by many microcomputer manufacturers. The keyboard can be manufactured to any configuration without having to worry about set-up or engineering charges.

Both products are produced by Dean Electronics, Glendale Park, Fernbank Road, Ascot, Berkshire.

Dean thermal printer.

NEWS

Tracing the Spectrum

IT IS now possible to draw maps, technical drawings, portraits and even cartoon characters in full-screen high-resolution with the Spectrum, using the minimum of memory and program code. The hardware device which permits the Spectrum to be used as a drawing pad is called the RD Digital Tracer. It resembles a horizontal mechanical arm which can be guided over pictures. As the arm traces the original picture on the board the picture will be transferred to the Spectrum screen. The pictures can then be copied to the printer or saved on cassette for recall at a later date.

The device consists of a mechanical digitiser which can be put on to a desk or a drawing board. The Tracer can draw over an area approximately 300 × 200 mm., though bigger versions are available to special order.

Software is also supplied with the Tracer which will enable outline drawings to be made quickly and easily and then shaded. The display file can also be saved for merging with the user's own programs.

The RD Digital Tracer costs £49.95 and is available from RD Laboratories, 5 Kennedy Road, Dane End, Ware, Herts, SG12 0LU.

RD digital tracer.

Promoting Alpha on EPROM

CAR MANUFACTURER Alfa Romeo is using a very interesting device in its sales promotions. It is a ZX-81 with external EPROM attached. The EPROM is being manufactured by Capital Computers and Abies Informatics has provided the program.

The control program is based in an EPROM cartridge programmed in Basic. That is unusual, because EPROM programming has usually been done in machine code. The program is burned into the EPROM and can be erased only by using ultra-violet light.

When the ZX-81 is switched-on the program is loaded automatically into the RAM of the ZX-81. All the salesman has to do then is to follow the program prompts.

Capital Computers plans to put the device on the market and sell it to ZX users. There will be a series of EPROM cartridges to go with the machine, which will then have the same ability as the Vic and Atari computers to use cartridges as an alternative to cassette. Programs will be available instantly from power-up, so the user will not have to worry about manual loading.

Further information on the EPROM can be obtained from Capital Computers, 1 Branch Road, Park Street, St Albans AL1 4RJ.

Electronics on show

AN EXHIBITION for electronics hobbyists is to be staged at the Royal Horticultural Hall, London for four days from November 10. Called Breadboard, it has been planned by Argus Specialist Publications, publisher of *Computing Today*.

Peter Freebrey, an organiser, said that it has a mainly electronics base but there will be some computers at the show.

One feature will be the computer corner which will have a ZX-81 and Spectrum on display. The idea of the corner is to allow people who have never used computers previously to have hands-on experience.

Sinclair Research will not be at the show. The reason seems to be that the show is expected to attract electronics rather than computer hobbyists.

Among the exhibits will be a feature on war gaming, with two computers playing a war game with each other. An exhibition of holograms — three-dimensional images created by light patterns—will also be on view.

The show will be centred on the Royal Horticultural New Hall in Greycoat Street—not in Vincent Street.

Portable Sinclairs

USERS of the ZX-81 and Spectrum sometimes need to take their machines to clubs and exhibitions. Now Computer Aided Design has produced a range of products, called Jigsaw, which will make it easier.

The range includes an attache case and an interface connector. The attache case will have compartments for a RAM pack, a keyboard, floppy discs, printer, flat-screen television, cassette players, modem and rechargable battery, as well as space for the ZX-81.

Contact Computer Aided Printing Services Ltd, 28 The Spain, Petersfield, Hampshire, GU32 3LA.

NEWS

ZX-81 programs for the Spectrum

THE PROBLEM of loading ZX-81 programs into the Spectrum has been eased by East London Robotics. It seemed to be insoluble when the first Spectrums left the production lines. Even Clive Sinclair said that because of the difference in the data-transfer baud rate of the machines and language incompatibilities, loading ZX-81 programs directly on to the Spectrum was something which could not be done.

The answer is in the form of a hardware device, together with a control program. To load a ZX-81 program, the control program must first be loaded into the Spectrum. The ZX-81 program can then be loaded on to the Spectrum by following the prompts given by the Slow Loader control program. Those prompts appear in the form of several menus of options. The user selects the options, depending on how the incompatibilities are to be dealt with.

The incompatibilities between the machines include SCROLL and graphics characters on the ZX-81 and the INVERSE command on the Spectrum. The Slow Loader uses machine code routines to deal with all the problems except for INVERSE, which cannot be translated.

East London Robotics also produces 64K of add-on RAM for the Spectrum. It takes the Spectrum memory capacity up to 80K. The memory is put under the keyboard into the sockets which are provided for the Sinclair 32K memory add-on.

Both products are available from East London Robotics, Finlandia House, 14 Darwell Close, East Ham E6 4BT. The Slow Loader costs £10 and 64K RAM costs £50. The RAM is also available as a kit for £44.

Non-wobble RAM

A NEW RAM pack designed to eliminate RAM wobble and disconnection problems has been produced by Ground Control. The company says that the ZX-81 can be picked up and shaken and the RAM pack will stay in position. The RAM packs are manufactured by injection moulding so that the contours of the case are absolutely correct for fitting on to the ZX-81. Each 16K unit costs £19.95.

Ground Control also provides a keyboard sounder as an optional extra. The sounder is fitted inside the case to permit the user to enter programs faster and with more accuracy, as it gives an audio feedback when a key is pressed. The company also says that the device also helps to reduce eye-strain because the user does not have to look at the keyboard so often to check whether a key has been pressed.

The distributor claims a fast turnover of orders. For credit-card transactions, units will be mailed by return of post and for cheques and postal orders deliveries should be made within four days.

Further information from Ground Control, Alfreda Avenue, Hullbridge, Essex, SS5 6LT.

Ground Control RAM pack.

Sinclair market expands rapidly

THE SINCLAIR market is still expanding rapidly and new companies are producing add-ons and software every month. Companies are dealing more in the Spectrum but sales of ZX-81s are still increasing.

The ZX-81 is now of interest to electronics hobbyists who can use it to discover more about computer architecture.

Companies have been set up to try to cope with the demand for Sinclair products. One is Prism Microproducts, which has more than 200 retailers throughout Britain. At the moment Prism is responsible for wholesaling the ZX-81, printer and software but managing director Bob Denton hopes to be selling the complete Sinclair range before long.

Prism is also receiving samples of products from other companies in the Sinclair market. Denton wants to sell the best of them through Prism in an effort to standardise the market.

He also wants Prism to market its own ZX-81 and Spectrum products. They would be produced by independent companies and individuals especially for Prism, which is a sister company of ECC Publications, which publishes *Sinclair Projects*.

In addition, the number of national chains stocking the ZX-81 is growing. Apart from W H Smith, it is being sold by Boots, Dixons, Rumbelows and Wigfalls.

Soldering on to a perfect finish

The ability to use a soldering iron is of major importance in any electronic projects. David Elbee gives a simple guide on how to make it seem easy.

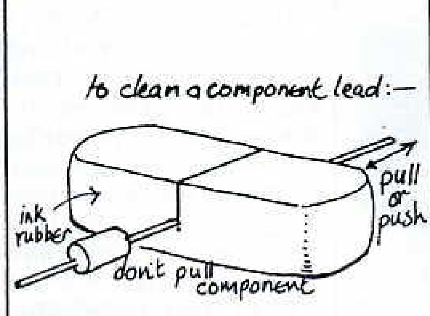
SOLDERING is easy, isn't it? Well, it is once you can do it but at first it seems almost impossible. The best way to learn to solder is to watch somebody who does it well and then to try it yourself while they see where you are going wrong.

Nevertheless, I will try to tell you how to make good soldered joints without 'frying' your components, resistors, transistors—and fingers.

Of the things you need, the most important tool obviously is the soldering iron. For working on printed circuit boards, Veroboard and the kind of circuitry we are concerned about, I suggest you use a small lightweight iron of no more than 15 watts power. I use both an Autex C-240 with 1/32 in., 3/32 in. and 5/32 in. bits; and a low-voltage Oryx 6V 6-watt miniature soldering iron for really small jobs. Other manufacturers produce equally suitable small lightweight irons. I also suggest you buy a soldering iron stand as well.

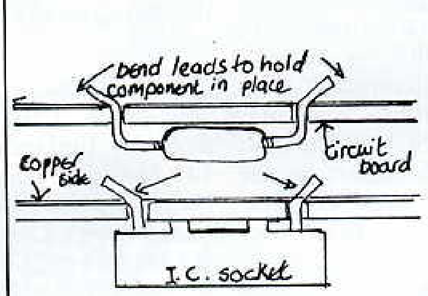
You many wonder why I use three

Figure 1



different sizes of bit. The answer is that the bit is a store of heat and the bigger the bit the more heat it stores, so if I am making very small joints I use the 1/32in. bit and for larger ones on switches or terminals I use the 5/32in. one. If I use the 1/32in. one on

Figure 2



large joints all the heat flows out of the bit into the joint and there is not sufficient to heat the joint and bit to a high enough temperature for the solder to flow. I know the soldering iron bit is being heated by the electric element in the iron but that is being done only slowly and we need fast heat transfer to the joint, or we can over-heat the components being soldered. On the other hand, if I am making very small joints the 5/32in. bit is often too big to reach the joint without touching something I do not want it to touch.

For soldering electronic components we need to use a good quality resin-cored solder made specially for electronics work. The resin core, when heated by the soldering iron, melts into a flux which helps heat transfer to the joint and mildly cleans and protects the components from the air while they are being soldered, and because when the joint has cooled the flux has solidified in all the nooks and crannies it is vital that it does not contain harmful chemicals which must be washed away.

The cored solder which you can buy from a local ironmonger may or may not be satisfactory but I wouldn't use it. I use Ersine Multicore five-core solder in a 0.71mm. size but any cored solder you buy from a reputable component supply shop or radio/TV repair shop should be suitable, provided it is a small diameter size.

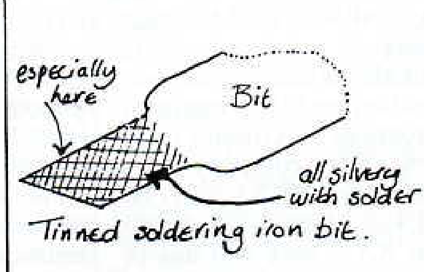
A damp paper towel is needed to clean the hot bit before starting to solder and to clean the flux from the bit after each joint before you return the iron to its stand. Soldering iron stands usually have a piece of sponge but I prefer the damp towel.

I never use heat shunts; most components will tolerate their leads being at the temperature of molten solder for five to 10 seconds and that is ample time to make a soldered joint.

Some people would say you need a small pair of round-nosed pliers or tweezers for bending component leads. They are useful to have but most times I just bend the leads with my fingers.

An ink rubber is useful. If you

Figure 3



make a slit in one and draw a component lead through it—figure one—it will clean-off all the dirt, grime and grease from the lead. Normally that is unnecessary but sometimes a batch of resistors can be difficult to solder. You can also use it to rub over the copper strips on the circuit board to make them shine; that makes them easier to solder and will not damage them.

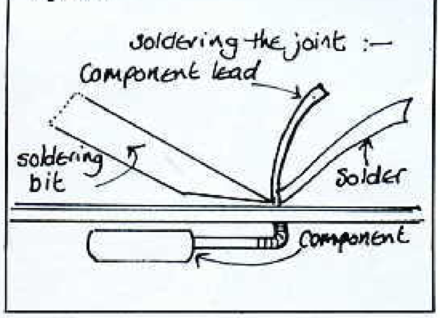
Blu-tack is very usful for holding components in place in a circuit board until they are soldered and saves burnt fingers.

HOW TO SOLDER

Now we have discussed what you need, we can proceed to the process.

To start, though, I would have a few integrated circuit sockets and a small piece of Veroboard and practise soldering the sockets in place. That way it does not matter if you make a mess of the first few joints,

Figure 4

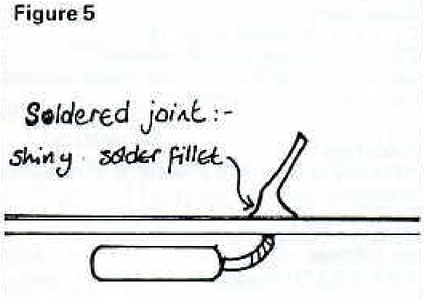


because at the end you can just throw away the assembly and put the small cost down to experience.

Before you begin, prepare a space to work on. Do not work on a polished table; components leave scratches and hot solder makes little hard burnt patches. Protect the surface with two newspapers or a sheet of hardboard or cardboard.

Switch on the iron and leave it for five minutes to warm-up and stabilise at the proper temperature. Put a component in the circuit board and bend the leads a little where they protrude the other side, to hold it in place—figure two. Blu-tack also

Figure 5



helps but do not use it on the copper side of the board—it leaves something behind which makes soldering difficult. Make sure the circuit board cannot move when you touch it with the iron—stick it down with Blu-tack.

Then wipe the soldering iron bit on the damp towel to clean it; it should be a silvery colour all over the part which will be in contact with the joint—figure three.

Wait for at least 10 seconds for the tip of the bit to return to temperature and touch the end of the bit with the end of the solder to put some molten flux on the bit. Then touch the joint with the bit and immediately afterwards touch the joint and the end of the bit with solder and feed in the solder as it melts—figure four.

Almost immediately the flux should flow over the joint, to be followed quickly by the molten solder which should form a fillet at the joint—figure five. As soon as the molten solder has formed a fillet, stop feeding-in the solder and take away the iron. From the time you touched the bit to the joint to the time you took it away should be no more than about four seconds. Then wipe the bit on the damp towel to clean off the flux and excess solder.

Do not disturb the component until the joint has set. That will take from two to four seconds. If you disturb it while it is cooling you will break the solder connection in the joint and have what is known as a dry joint, which does not conduct electricity very well. If you make a dry joint re-melt the solder at the joint and let it set again.

Then cut off the component lead about 1/16in. from the circuit board. Do not bother to cut off the pins of integrated circuit sockets, even though they may be fractionally longer—figure six.

Inspect the joint carefully; it should look like figure five and there should be no solder splashed around the joint or solder bridges to other components.

When you have finished soldering-in all the components inspect the board carefully for joints you have missed, solder bridges, solder splashes which may short-out something. If there is a quantity of flux on the board, and to ease inspection, you can clean-off the flux with methylated spirit and an old toothbrush but be careful—the spirit may dissolve some components. Now to look at what can go wrong:

—The bit may be too small for the joint and the joint does not heat up in time. In that event, try a bigger bit.

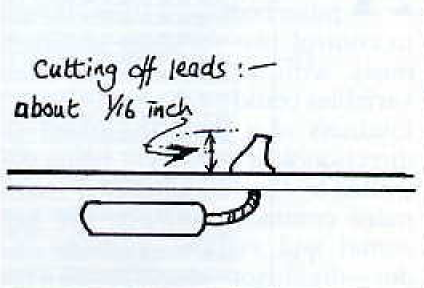
—The iron has not been switched on long enough and has not reached temperature. Wait a short time.

—The bit is dirty and/or it is not shiny with solder—a bit which is shiny with solder is technically called "tinned". Clean it on the damp towel and apply some solder.

—The component is dirty. Try the ink rubber on its leads. As a last resort try scraping the leads gently with a knife.

Some old plastic-covered wire gives off some chemical which seems to prevent the solder flowing over the

Figure 6



joint. That is generally green plastic for some reason. Do not use it.

Get the joint too hot by keeping the bit on it too long and the component will burn and/or the copper will come off the circuit board. If that is happening, you need more practice.

Solder bridges to other components caused by too much solder or too big a bit can be carefully removed by stroking with the bit.

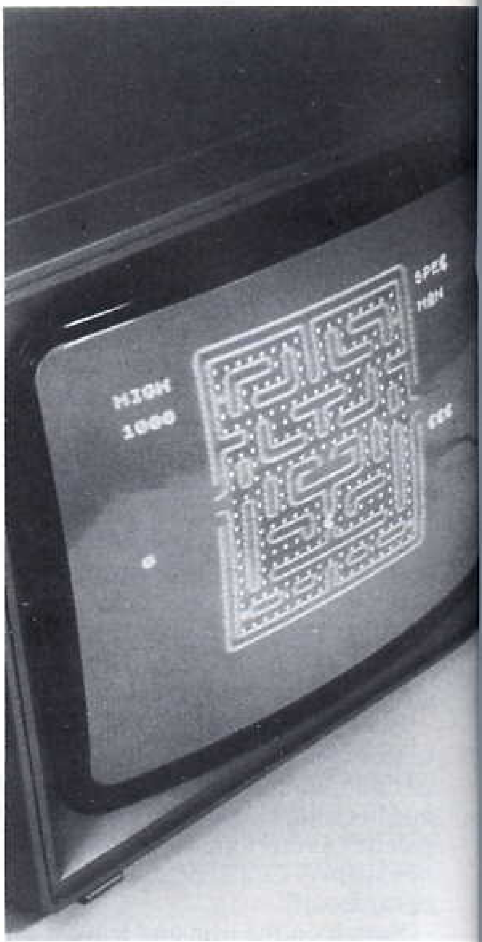
Solder splashes happen to everybody sometimes. They should brush off; if not, try stroking gently with the bit.

Let me repeat, soldering is not difficult providing you do it the correct way. What you are trying to do is to get the molten solder to wet the surface of the things to be joined so as to form a good electrical contact. Consequently things must be clean and not moved while they are setting.

That said, soldering really is easy. Good luck.

How to move in two directions at the same time

A joystick is a useful and versatile addition to a computer because it allows the user to control two variables simultaneously with a single lever. Those variables could be the frequency and loudness of a tone or the speed and direction of a model car being controlled by the computer. Dave Sanders explains how to build one in three simple sections.



A JOYSTICK is a useful and versatile addition to a computer because it allows the user to control two variables simultaneously with a single lever. Those variables could be the frequency and loudness of a tone, the speed and direction of a model car being controlled by the computer or, to take a more common example, the horizontal and vertical positions of a dot—the cursor—displayed on a television screen.

To build and operate a simple two-axis joystick interface for the Spectrum, the interface consists of three sections—the joystick mechanism, an electronic interface circuit which produces a signal from the joystick and feeds it to the Spectrum, and a short machine code program which converts the incoming signal into numbers in the computer. The unit is powered directly from the computer power supply via the edge connector.

The joystick consists of two potentiometers linked mechanically to a single lever. Movement of the lever in the left-right direction, the X-axis, causes a corresponding movement of the slider contact of the X-axis potentiometer. Similarly an up-down—Y-axis—movement adjusts the slider on the Y-axis potentiometer.

The interface circuit contains a square-wave oscillator which produces an output signal which switches continually between approximately 5V and 0V. Those voltage levels correspond to the logic values high and low respectively. A short section of the output signal is shown in figure one.

The X-axis potentiometer acts as a variable resistor and controls the length of time for which the output is in the low state, so that as the resistance is increased; by moving the lever to the right, the low interval of the output signal becomes longer. Moving the lever to the left reduces the resistance and causes the low time to become shorter again.

The Y-axis potentiometer controls the high interval in a similar manner; moving up the lever increases the interval and moving it down reduces it. When the computer performs an IN 255 command the simple input circuit formed by ICs one and two samples the output level of the square wave oscillator and feeds it to the computer.

The program which talks to the input circuit is written in Z-80 machine code. In simple terms, that return routine inputs the signal from the interface until it finds a step from high to low—point one in figure one. It then counts how long the signal remains low. When the signal goes high—point two in figure one—the routine switches to a second counter and times the duration of the high

COMPONENTS

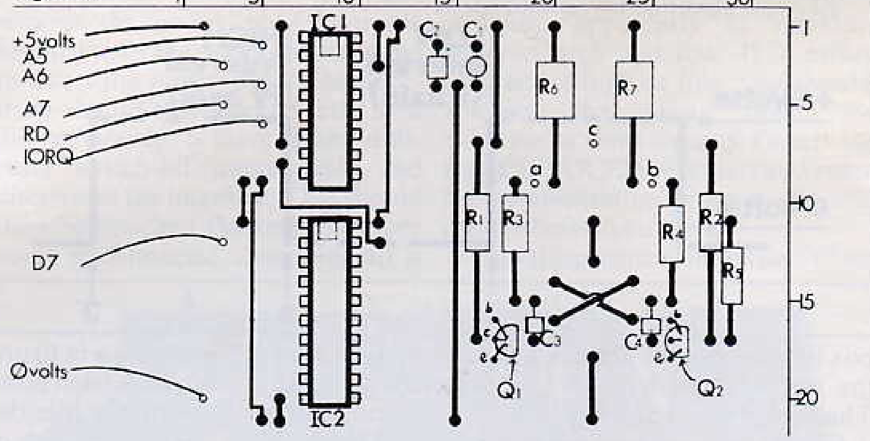
Semiconductors
Q1 & Q2 NPN transistors 2N3705
IC1 74LS138
IC2 74LS245

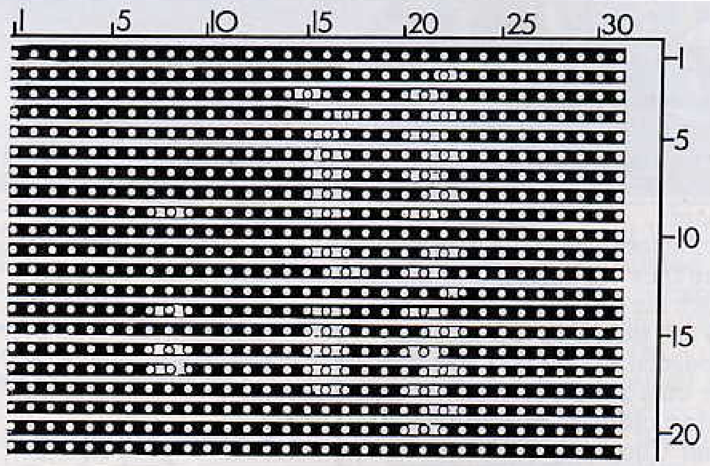
Capacitors
C1 4.7 uF tantalum bead, 16V
C2 0.1 uF ceramic miniature disc
C3 & C4 0.0022 uF monolithic ceramic capacitors (10% tolerance)

Resistors
All carbon film 0.33 watt 5% miniature resistors:
R1 & R2 2.2 Kohm
R3 & R4 10 Kohm
R5 1 Kohm
R6 & R7 220 Kohm

Miscellaneous
Veroboard type 10345, 0.1in. matrix, 127mm.x63mm.
1m ribbon cable, 10-way
Maplin two-axis joystick control, with 220 Kohm potentiometers
Metal panel box, Maplin type M4005, or equivalent
28-way double-sided edge connector for Spectrum.
Four self-tapping screws, 6BA x 3/8in.

Figure 4:



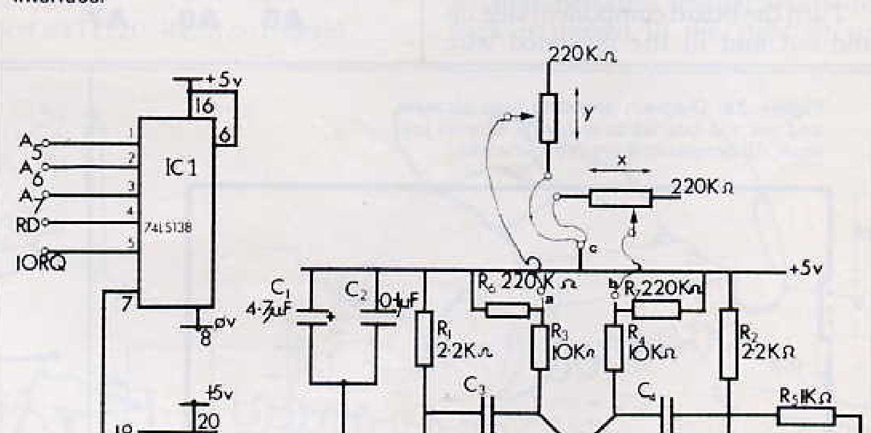


interval. Finally, when the signal goes low again—point three in figure one—the counting stops.

The routine compresses the two values into one number and puts that in the variable specified in the USR function used to start the routine. The Basic commands in line 1110 then extract the X and Y counts from the number and put them into the variable x and y.

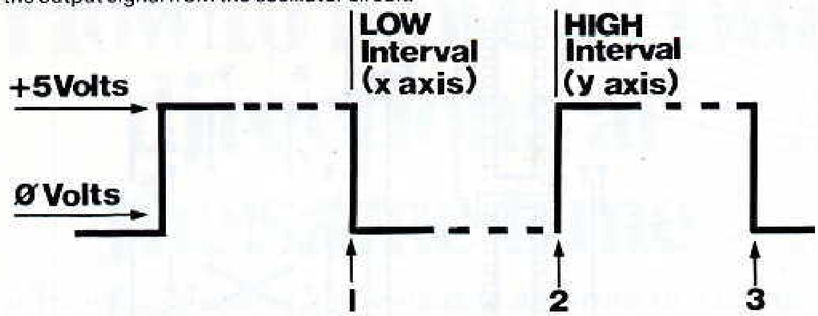
The first construction step is to cut the lid of the box to accept the joystick unit. The positions and sizes of the holes needed for the Maplin joystick we have used are shown in figure 2a. If you decide to use a joystick of a different size you obviously will have to determine the dimensions of the holes for yourself. Remember, however, to make the central hole big enough to allow the lever its full range of movement and to leave room in the box for the circuit board. It is also necessary to file a shallow slot in the edge of the

Figure 3. Circuit diagram for the joystick interface.



Joystick Controller

Figure 1. An example of a short section of the output signal from the oscillator circuit.



box lid opposite the joystick to allow the ribbon cable to enter the box. That is also marked on figure 2a.

Cut a piece of Veroboard 3.3in. along the tracks by 2.5in. across. Place the board with the strips uppermost and, remembering that you are working on the opposite side of the board from that shown in the layout diagram in figure four, mark the positions of the breaks in the tracks on the board.

Check the location of the marks to make sure they are correct and then cut through the corner tracks at those points. If you do not have a spot face cutter designed for the job you can make the cuts almost as easily with the top of an ordinary twist drill held in the hand. Check that the breaks are complete and clean away any surplus pieces of copper.

Turn the board component side up and cut and fit the insulated wire links in the positions shown in figure four. Check that they have been positioned correctly and then solder the links to the strips on the under-side of the board.

Next bend the leads of all the components to fit into their correct holes. Then mount and solder into place first the resistors and then the capacitors. Take care to mount the tantalum bead capacitor correctly so that the lead marked with a + is connected to the 5V supply. Fit the two transistors Q1 and Q2 and the integrated circuits IC1 and IC2, taking care to see that they are positioned exactly as shown in figure four, i.e., with the dots or cutouts on the integrated circuits nearest the top edge of the board and with the flats on the transistor packages facing to the right.

Try not to apply the soldering iron for long periods when soldering the components, as they will be damaged by excessive heat. To complete the board push the Veropins into the holes marked in figure four and solder them in place. Finally, check the underside of the board for any dry joints or splashes of solder which might short adjacent tracks.

Then take an 8-way piece of ribbon cable and connect the pins at

Figure 5. Diagram showing the positions of the required contacts on the 28-way Spectrum edge connector.

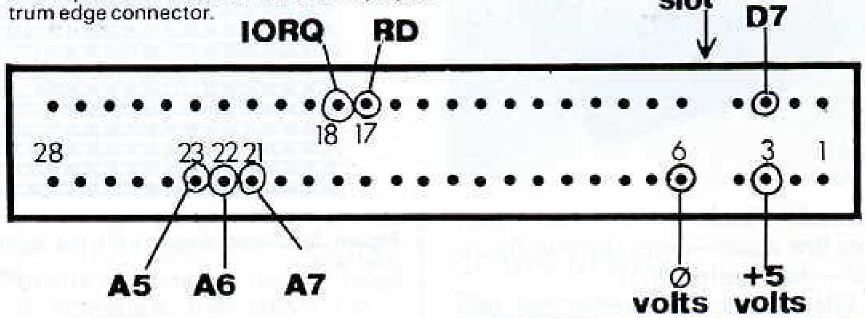
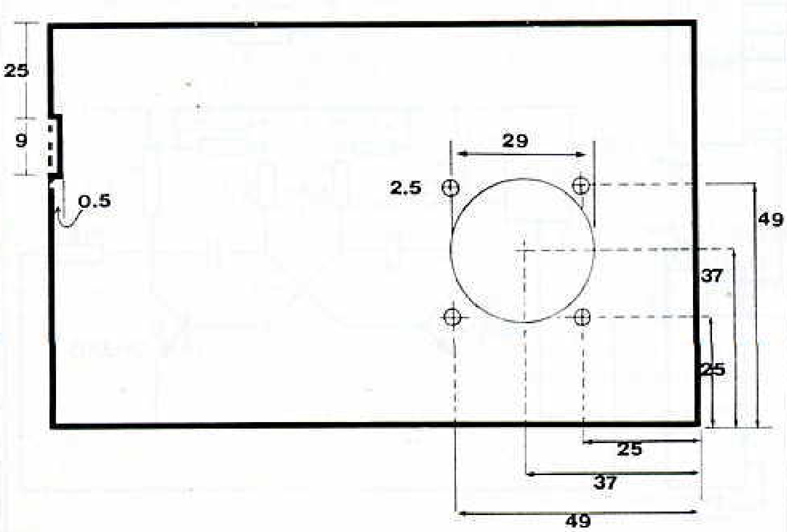
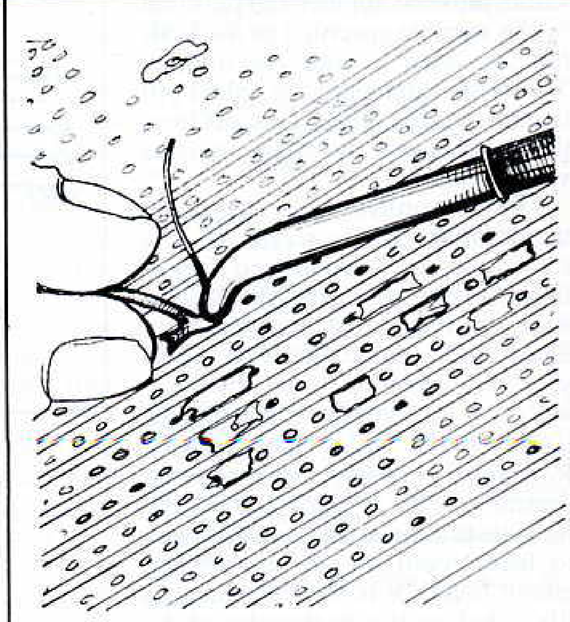


Figure 2a. Diagram showing how to mark and cut the box lid to accept a Maplin joystick. All dimensions are in millimetres.





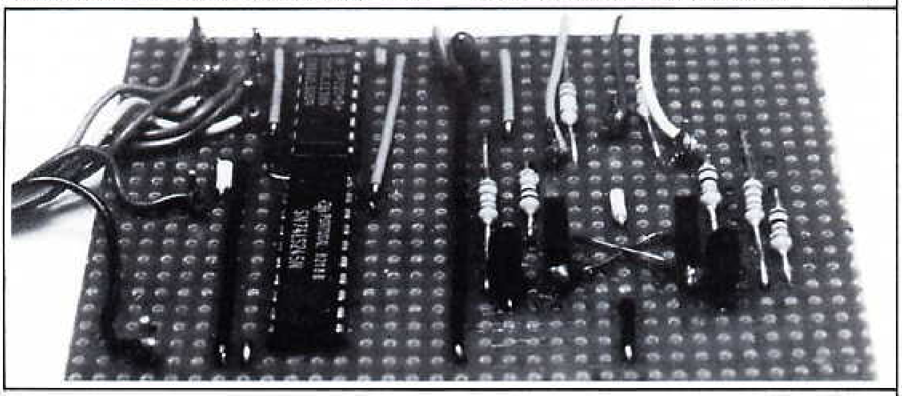
Joystick Controller

the left-hand edge of the circuit board to the 28-way edge connector. The positioning of the relevant contacts on the edge connector are shown in figure five. Double-check that you have wired the contacts to the correct pins on the board, since the computer may be damaged if those connections are incorrect.

The last step in the wiring is to connect the joystick. The sketch in figure 2b shows a view of the joystick as seen from the front of the box and illustrates how to wire the potentiometer tags to pins a, b and c on the circuit board—using insulated wire. If you are not using a Maplin joystick you should connect the centre tag of the X-axis potentiometer to pin b, the centre tag of the Y-axis potentiometer to pin a, and then connect one of the other terminals on each potentiometer to pin c. The tests detailed will soon show whether those connections are correct.

Screw the joystick unit into place on the under-side of the box lid and fit the circuit board into the box. The board may be held in place with a sticky-fixer at each corner but make sure that it touches no metal parts. Finally, assemble the box so that the connector cable emerges from the slot on the left-hand side. You are then ready to "fire-up" the interface on your Spectrum.

In testing, setting-up and use, remove the power plug from the Spectrum, fit the edge connector and re-insert the power plug. The Spectrum should still work exactly as it did previously. If there is any difficulty switch-off immediately and disconnect the interface. That should then be checked thoroughly before being re-connected. Assuming all is

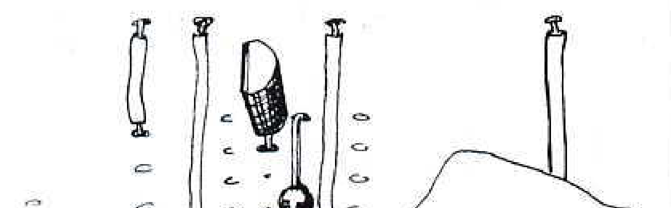


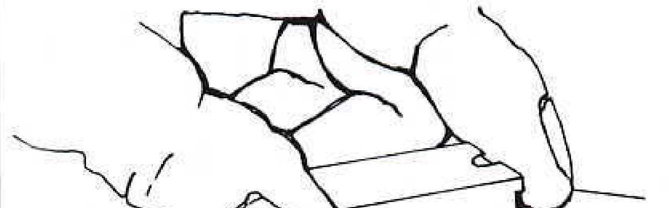
well, type and run the following program:

```
10 REM joystick test
20 LET a=IN 255: REM read joy-
stick output
30 IF a=255 THEN PRINT
"  HIGH"
40 IF a=127 THEN PRINT
"  LOW"
50 POKE 23692,255: REM keep
scrolling
60 GOTO 20: REM do it again . . . .
```

That should print a message which switches, apparently at random, between high and low. If it prints only either high or low, you should re-check the circuit board for mistakes or short circuits. Otherwise type CLEAR 32549 (enter) and enter the demonstration program. Save it on tape before you run it.

Run the program and press "1" for a listing of the X and Y values from the joystick. Move around the lever and watch how the numbers vary. Moving the stick from left to right—X-axis—should alter the X value. If it alters the Y value instead you have the potentiometer connected to the wrong input pins. Return to the circuit board and swap the wires from the joystick to pins a and b. If the X or Y value becomes smaller when the stick is moved to the right or up





Joystick Controller

respectively you have the 5V supply connected to the wrong end of the relevant potentiometer, so unsolder the wire from the tag on the potentiometer and connect it to the one on the opposite side of the centre tag.

Then check the range of the values. Push the lever hard to the left and the X value should decrease to zero. If it does not reach zero, you can trim the joystick by increasing the number in the data statement gradually in line 41 of the demonstration program.

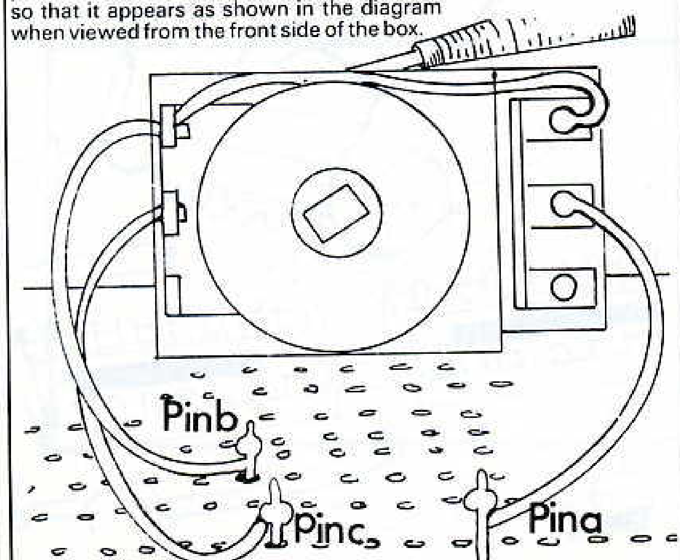
To do that list the program, edit the line and then re-run the program and check the values once more. The value will probably lie between 5 and 15. The Y zero can be trimmed in the same way by pushing the lever hard down and altering the value in line 43. You should not alter any other numbers in the data statements or you will corrupt the machine code routine.

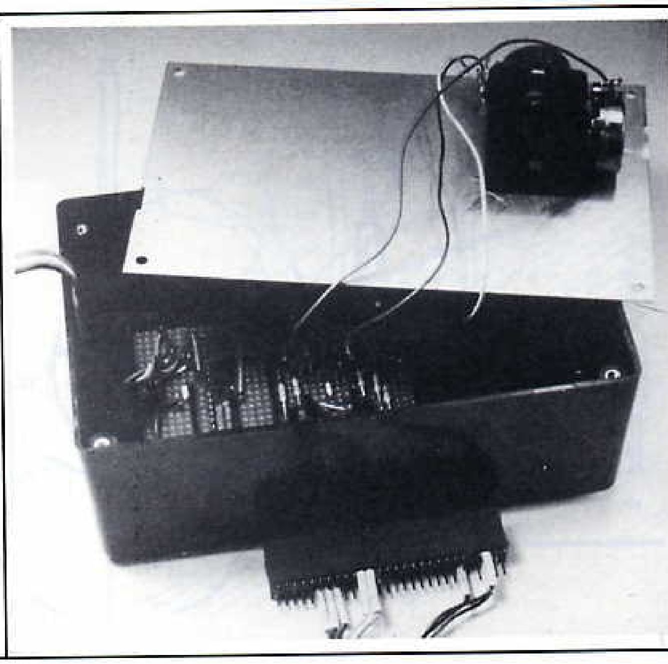
When all is satisfactory, run the demonstration program again and press "d". You can then use the joystick to control the direction and speed of the cursor—small black dot—on the screen and to draw pictures by holding down key "q"—release key "q" to move the cursor without drawing. To use the joystick in your programs CLEAR 32549 before entering them and then include lines 10 to 60 at the beginning of your program and use the subroutine at lines 1100 and 1130 to return the X and Y values in the variables x and y.

Remember to have the joystick connected before running the program or it will remain in an endless loop in the machine code.

```
   1 REM    JOYSTICK INTERFACE
  2 REM             PROGRAM
  4 REM
  5 REM    enter machine code
  6 REM
 10 LET a=32550
 15 FOR i=1 TO 43
 20 READ n: POKE a,n
 30 LET a=a+1
 35 NEXT i
 40 DATA 22
 41 DATA 3
 42 DATA 30
 43 DATA 3
 45 DATA 219,255,203,23,48,250,
219,255,203,23,56,250
 50 DATA 21,32,253,219,255,203,
23,56,3,20,24,247,29,32,253,219,
255
 60 DATA 203,23,48,3,28,24,247,
66,75,201
 99 REM
 100 REM  print or plot?
 101 REM
 110 CLS : PRINT "  JOYSTICK INT
ERFACE PROGRAM"
 120 PRINT : PRINT : PRINT "Pres
s ""l"" to list X and Y"
 125 PRINT "values from joystick
"
 130 PRINT : PRINT "Press ""d"""
to enter ""draw""routine"
 140 PRINT : PRINT "  Press ""sp
ace"" to leave either"
 145 IF INKEY$="l" THEN GO TO 50
0
 150 IF INKEY$="d" THEN GO TO 60
0
 160 GO TO 145
 499 REM
 500 REM  print x and y values
 501 REM
 505 CLS : PRINT "   X         Y
": PRINT
 510 GO SUB 1100: LET x=b: LET y
=c
 520 PRINT AT 3,0;"
"
 530 PRINT AT 3,3;x: PRINT AT 3,
13;y
 540 IF INKEY$=" " THEN GO TO 10
0
 550 GO TO 510
 599 REM
 600 REM  draw routine
 601 REM
 610 CLS : PRINT "This routine a
llows you to draw"
 615 PRINT "on the screen with t
he HiRes"
 620 PRINT "graphics,"
 630 PRINT : PRINT : PRINT "
Hold down ""plot"" (key q)"
 635 PRINT "to draw a line with
the cursor"
 640 PRINT : PRINT "    Press ""
cls"" (key v) to"
 645 PRINT "clear the screen and
 start again"
 650 PRINT : PRINT "    Press ""
space"" to quit the": PRINT "rou
tine"
 680 PRINT : PRINT "    Press c
to continue"
 690 IF INKEY$<>"c" THEN GO TO 6
90
 700 CLS : LET e=128: LET g=128:
 LET f=88: LET h=88
 710 PLOT OVER 1;e,f
 730 REM
 740 REM  get co-ords from joyst
ick & scale them
 745 REM
 750 GO SUB 1100: LET x=b-7: LET
 y=c-7
 755 IF INKEY$="q" THEN GO TO 86
5
 760 LET g=g+INT (x/2): LET h=h+
INT (y/2)
 765 REM  keep cursor on screen
 766 REM
 770 IF g<0 THEN LET g=0
 780 IF g>255 THEN LET g=255
 790 IF h<0 THEN LET h=0
 800 IF h>175 THEN LET h=175
 820 IF INKEY$="v" THEN GO TO 70
0
 830 IF INKEY$=" " THEN GO TO 10
0
 840 REM  move cursor
 845 REM
 850 PLOT OVER 1;e,f: PLOT OVER
1;g,h
 860 LET e=g: LET f=h: GO TO 750
 862 REM
 863 REM  draw line
 864 REM
 865 LET i=INT (x/2): LET j=INT
(y/2)
 867 LET k=g+i: LET l=h+j
 870 IF k<0 OR k>255 THEN GO TO
750
 875 IF l<0 OR l>175 THEN GO TO
750
 880 DRAW i,j
 890 LET e=k: LET f=l: LET g=k:
LET h=l: GO TO 750
 999 REM
1000 REM  read the joystick
1010 REM  x value returned in b
1020 REM  y value returned in c
1021 REM
1100 PAUSE 1: LET a=USR 32550
1110 LET b=INT (a/256): LET c=a-
256*(INT (a/256))
1130 RETURN
```

Figure 2b. Diagram showing how to connect the potentiometers on the Maplin joystick to pins a, b and c. The joystick must be mounted so that it appears as shown in the diagram when viewed from the front side of the box.





WORD PROCESSOR

Better text handling on the Spectrum

Word processors save a great deal of time. They reduce the amount of re-typing necessary to produce a finished piece of writing and the quality tends to be better. Randle Hurley, who included a word processor in his recent book of practical uses for the ZX-81 here reveals some guidelines for using the spectrum as a word processor.

THIS COLLECTION of word processing routines is part of a series of text-handling programs written specially for the ZX range of computers. Word processors save a great deal of time. They reduce the amount of re-typing necessary to produce a finished piece of writing. More than that, the quality of the product tends to be better than it would be without the processor.

Small improvements in the structure of a piece of writing cost a disproportionately large amount of trouble. Before printing, corrections often have to be made. Spelling and grammatical mistakes need to be rectified. Additions may be needed and unwanted text might have to be removed. A word processor will perform all those tasks and offer an immediate opportunity to assess the effects of the changes. If you do not like the new version, it can be edited again.

Word processing facilities could be useful in other programs where text output is a feature. The problem is that the word processing programs are very big. They tend to fill the computer. All the space which the program does not occupy is given to storing the text. If one would like to use the benefits of text editing in another program, the two will not fit into the machine at the same time.

Figure 1

```
Sample before Formatting

This is a test piece of writing.
 It was written without trying t
o end lines with complete words.
 Some of the lines start with sp
aces and it is likely that some
may even start with punctuation
marks. The piece was written to
test out the set of routines whi
ch form the basis of this articl
e. There is a routine to format
text before writing which can ju
stify the left hand margin alone
 or both left and right before t
he text is printed. Other routin
es organise "word wrap", text st
orage and editing.
```

The routines listed have been developed to allow Spectrum users to use the essential elements of a word processor, merged with other major programs. The routines are short and use few variables. The whole set may be used or any combination can be selected according to preference. The jobs which the routines cover are justifying the margins, avoiding the splitting of words across two lines, and storing the text in some convenient form for editing.

Figure 2

```
After left hand justification

This is a test piece of writing.
It was written without trying to
end lines with complete words.
Some of the lines start with
spaces and it is likely that
some may even start with
punctuation marks. The piece was
written to test out the set of
routines which form the basis of
this article. There is a routine
to format text before writing
which can justify the left hand
margin alone or both left and
right before the text is
printed. Other routines organise
"word wrap", text storage and
editing.
```

Some people find the appearance of right-justified text rather unnatural, while others much prefer it to a ragged right-hand margin. However you prefer your margins, some things cannot be tolerated. Lines must not start with spaces unless there is good reason and punctuation marks must appear at the start of lines only if they are preceded by a space in the text. All the text produced by the routines will be left-justified according to these rules. Right-hand justification can be switched-on by setting a flat, rj, from 0 to 1. The formatting routine will put its output on to the screen. It is a matter of convenience if the PRINT statements are accompanied by LPRINT statements or if a screenful of text is allowed to build, to be copied and then cleared away for the next block. Figures one, two and three show the different formats.

Figure four shows the first of the routines which carries out the formatting. The by-pass at line 1 sends the computer to the main part of the program. The routine is called into play by a GOSUB call. You will have to replace line 28 with a simple RETURN statement.

The routine is allowed to stop at line 28 when the whole of a $ has been formatted and printed. That is convenient for testing the operation of the routine but a RETURN will be needed in the working version. There is a REM statement at line 29 to remind you that the flag needs to be set before the routine is called.

The next part of the set trims the text as it is entered. This word wrapping makes it easier to check the material on the screen and to visualise the final appearance of the text. Figure five shows the effect of the routine on a partly-filled screen. The word routine normally would split at the end of the line but the computer moves the word to the next line to be finished.

The word wrap facility in figure six is part of the main text entry routine. The keyboard is live while the routine is working and that means that the keyboard click is lost. To some people the click is valuable feedback, while others find it intensely annoying. Those who would prefer not to hear the click should delete the BEEP .005,0 from line 13. When trying the routine it is convenient to stay inside the loop but when using the routine in earnest, the STOP command

Figure 3

```
After justifying both margins

This is a test piece of writing.
It was written without trying to
end  lines  with complete words.
Some  of  the  lines  start with
spaces  and  it  is likely that
some    may    even  start  with
punctuation marks. The piece was
written  to  test out the set of
routines which form the basis of
this article. There is a routine
to  format  text  before writing
which  can justify the left hand
margin  alone  or  both left and
right    before    the   text  is
printed. Other routines organise
"word  wrap",  text  storage and
editing.
```

WORD PROCESSOR

Figure 4

```
Formatting routines
    1 GO TO 100: REM By-pass the
routines
    2 LET b$=b$( TO len-1)
    3 LET j=1
    4 IF LEN b$=32 OR rj=0 THEN P
RINT b$: RETURN
    5 IF b$(j)=" " THEN LET b$=b$
( TO j)+b$(j TO ): LET j=j+1
    6 LET j=j+1: IF j>LEN b$ THEN
 GO TO 3
    7 GO TO 4
   20 LET nc=1
   21 LET len=33
   22 IF nc+len>LEN a$ THEN GO TO
 28
   23 LET b$=a$(nc TO nc+len)
   24 IF b$(1)=" " THEN LET nc=nc
+1: GO TO 23
   25 IF b$(len)<>" " THEN LET le
n=len-1: GO TO 23
   26 GO SUB 2
   27 LET nc=nc+len: GO TO 21
   28 PRINT a$(nc TO );: REM RETU
RN to an appropriate part of the
main program
   29 REM rj=the flag to switch o
n right hand justification
```

Figure 5

```
Word wrap in action

The word wrap routine trims the
text as it is entered. If a word
is likely to spill over the end
of a line then it is removed
from the screen and replaced on
the line below. Here is the rou
and when the word is complete...
..

The word wrap routine trims the
text as it is entered. If a word
is likely to spill over the end
of a line then it is removed
from the screen and replaced on
the line below. Here is the
routine working._
```

should move the machine back to the main program.

To allow that to happen, convert the REM statement at line 51 to 'IF CODE b$ = 226 THEN RETURN'. Shift/a—the STOP key— will then allow you to escape from the routine. While entering text, mistakes can be removed by means of the normal DELETE procedure, shift 0. This facility is intended only for minor correction. Major alterations to the text should be done while editing.

The editing routine might be used alone, to edit text from another source. The keyboard reading routine has been repeated because of the possibility. As written, the routine will allow the editing of the first 704 characters in a $. If a $ is shorter, a check will prevent the need for the user to edit non-existent material.

To edit the text beyond the first page, the variables a and b will have to be altered to point, respectively, to the first and last characters to be printed.

The paging routine will vary considerably from one program to the next, so that section has been left for the user to design according to the dictates of the task.

The normal cursor control keys, 5 to 8, allow the user to point to any character to be removed, or one ahead of the point at which new text will be added. Press the e key and then choose one of the options. If INSERT is selected, the Spectrum will ask for the new material. Enter it at the bottom of the screen and it will be inserted as soon as the ENTER key is pressed.

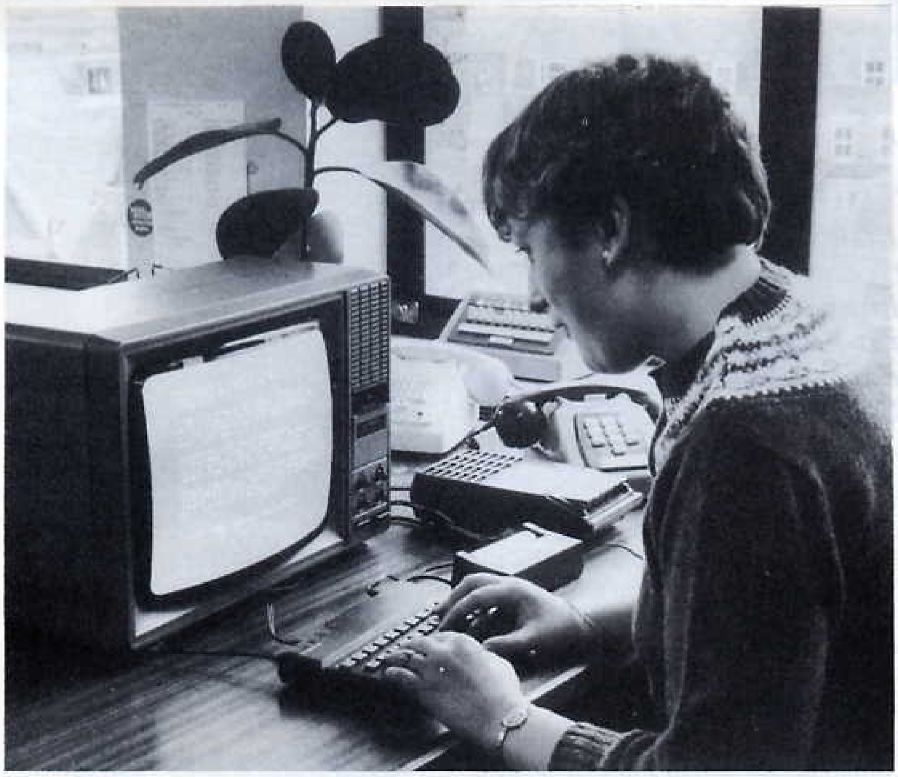
Figure 6

```
Entering and storing text with
automatic word wrap
   10 IF INKEY$<>"" THEN GO TO 10
   11 IF INKEY$="" THEN GO TO 11
   12 LET b$=INKEY$: IF b$="" THE
N GO TO 10
   13 BEEP .005,0: RETURN
   40 LET d=1: LET a$=""
   41 LET c=0: PRINT AT 21,0;
   42 GO SUB 10: IF CODE b$<32 OR
 CODE b$>126 THEN GO TO 50
   43 PRINT AT 21,c;b$;"_": POKE
23692,9: LET c=c+1: LET a$=a$+b$
: LET d=d+1
   44 IF c=32 THEN GO TO 46
   45 GO TO 42
   46 GO SUB 10: IF CODE b$<32 OR
 CODE b$>126 THEN GO TO 50
   47 LET a$=a$+b$: IF b$=" " THE
N GO TO 41
   48 IF SCREEN$ (20,c-1)<>" " TH
EN LET c=c-1: GO TO 48
   49 FOR j=c TO 31: PRINT AT 21,
j-c;SCREEN$ (20,j): PRINT AT 20,
j;" ": NEXT j: LET c=j-c+1: PRIN
T AT 21,c-1;b$: GO TO 42
   50 IF CODE b$=12 THEN LET c=c-
1: PRINT AT 21,c;"_ ": LET d=d-1
: LET a$=a$( TO d-1)
   51 REM If CODE b$=226(shift/A
for STOP) THEN RETURN
   52 GO TO 44
```

When DELETING, the computer needs to know the number of characters to be removed. When this is keyed, ENTER will remove the unwanted characters. Again, the routine has been written to be tested. An escape is needed in the working version or the user will be locked into the loop. The REM at line 80 is to remind the programmer to insert a RETURN statement to be executed when a suitable signal is given. The STOP key—shift/a—which was used in the text entering routines could be used again. The results can be seen in figures seven and eight.

The excellent ZX Basic string-handling facilities have been used to perform the editing work. The Spectrum will allow very long strings to build and string-slicing works very

WORD PROCESSOR



quickly, giving virtually instantaneous, on-screen editing. Figure nine is the code which makes editing possible.

The routines are brought into play be means of GOSUB calls from the main program. To start writing a new piece of text, call GOSUB 40. If an addition to the existing material is needed, the following commands should be given—PRINT AT 21,0: followed by GOSUB 42. Whichever call is made, the escape from the writing loop is made by keying shift/a.

Editing the first page of the writing is achieved by the call GOSUB 60. If other parts of the text need to be treated, the variable a should be set to the first character and b should be set to the last. GOSUB 62 allows editing of the specified text but be careful to specify only a screenful—704 characters—at a time. Again shift/a allows an escape to the main program.

When formatting the text for printing, set the right-hand margin flat rj, to zero for left justification or to 1 for justification of both margins. This routine needs the addition of LPRINT or COPY statements to allow the production of hard copy.

If each PRINT statement is accompanied by an LPRINT, a POKE may prove beneficial as well. When the screen is full the Spectrum normally asks if it should SCROLL. POKE 23692,9 in the line containing the PRINT statement allows the computer to SCROLL whenever it needs to do so and removes the necessity for pressing a key whenever the screen fills. There is an example for you to follow in line 43 of the text entering routine.

Figure 7

```
The editing facility
Spot the deliberation mistake.
In the next block the mistate
will have been removed and a new
sentence will have been added by
means of the editing routine.
```

Figure 8

```
After editing
Spot the deliberate mistake. In
the next block the mistake will
have been removed. To show the
versitility, a new sentence will
have been added by means of the
editing routine.
```

Variables are:

j general counter
rj rt justification flat
len line length
nc next character number
Text storage and word wrap variables
c column number of character
d character number in a$
Editing variables
a first character in block
b last character in block
F cursor column.

Figure 9

```
The editing routine
   10 IF INKEY$<>"" THEN GO TO 10
   11 IF INKEY$="" THEN GO TO 11
   12 LET b$=INKEY$: IF b$="" THE
N GO TO 10
   13 BEEP .005,0: RETURN
   60 LET c=1: LET e=10: LET f=0:
 LET b=LEN a$
   61 LET a=1: IF b>704 THEN LET
b=704
   62 CLS : PRINT AT 0,0;a$(a TO
b)
   63 PRINT AT e,f; OVER 1;"_"
   64 GO SUB 10: PRINT AT e,f; OV
ER 1;"_": IF b$="5" THEN LET f=f
-1
   65 IF b$="6" THEN LET e=e+1
   66 IF b$="7" THEN LET e=e-1
   67 IF b$="8" THEN LET f=f+1
   68 IF f<0 THEN LET f=f+32
   69 IF f>31 THEN LET f=f-32
   70 IF e<0 THEN LET e=0
   71 IF e>21 THEN LET e=21
   72 IF e*32+f>b THEN LET e=INT
(b/32): LET f=b-e*32-1
   73 IF b$="e" THEN GO TO 80
   74 GO TO 63
   80 INPUT "I insert D delete";b
$
   81 IF b$<>"i" AND b$<>"d" THEN
 GO TO 63: REM Or somewhere sens
ible
   82 LET a=e*32+f: IF b$="d" THE
N GO TO 85
   83 INPUT "Key new material";b$
   84 LET a$=a$( TO a)+b$+a$(a+1
TO ): GO TO 60
   85 INPUT "How many characters?
";e
   86 LET a$=a$( TO a)+a$(a+e+1 T
O ): GO TO 60
```

Driving force at a reasonable price

Dave Buckley details how to make a Latch-Card which is wired-up on Veroboard so that it can be built easily without having to send for a special printed circuit board or to have one specially etched. It is an easily-built, eight-bit, output memory-mapped latch at address 36850 for a ZX-81 which can be modified for the Spectrum.

LATCH-CARD is an easily-built, low-cost 8-bit output memory-mapped latch at address 36850 for a ZX-81 which can be modified for the Spectrum. The bits of the latch may be set and cleared by Basic POKEs. The latch, if PEEKed, will always return 255 regardless of the value POKEd.

It enables the ZX-81 or Spectrum to drive the Power-Card project.

Construction of the Latch-Card is different from other magazine projects in that it is wired-up on Veroboard so that you can build it easily without having to send for a special printed circuit board or having to etch your own.

The Veroboard used is made specially for integrated circuits and has the tracks already broken every four holes. You can buy it in pieces 5.85in. × 2.9in. and you will need to cut off a piece 3½in. long—figure two.

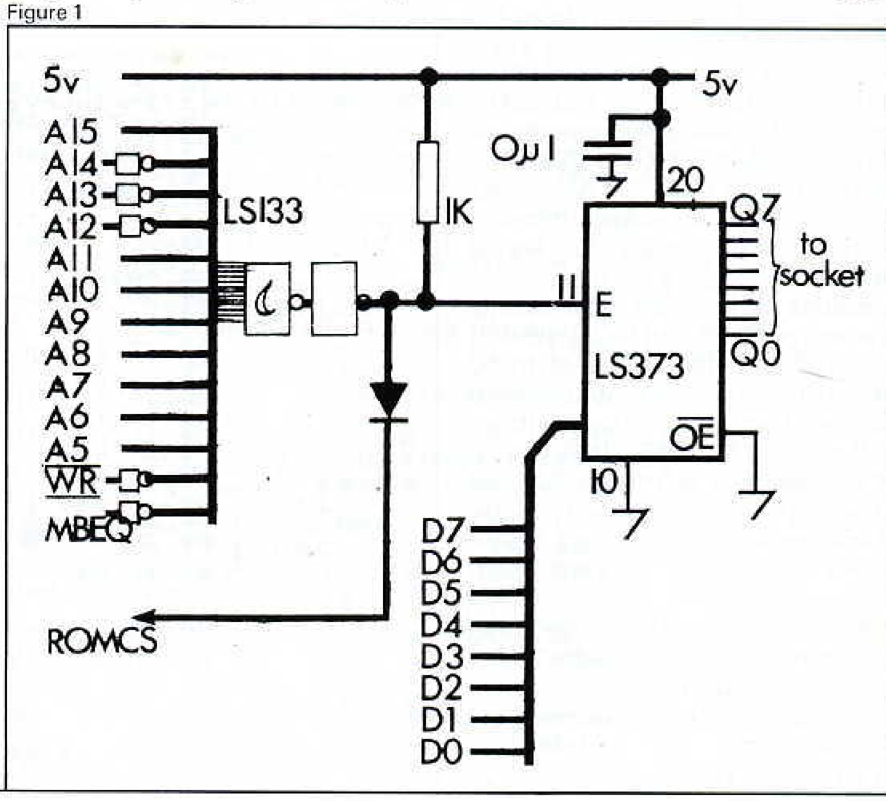
To make sure the board is wired properly it is best to follow a wiring schedule. All the pins on the same row of the wiring schedule should be connected together.

Start construction by soldering-in the edge connector, leaving ¼in. between the body of the connector and the Veroboard—figure one. If you wish to use the Latch-Card with other add-ons then, after soldering the edge connector gently, bend the pins towards each other and insert the extender card, making sure that the slot in the card is behind the blanked-off slot in the edge connector; then solder the pins to the tracks on the extender card.

Then solder-in the IC sockets. One 16-pin socket is for the output. The 20-pin socket is for the 74LS373. The other 16-pin socket is for the 74LS133 and the 14-pin socket is for the 74LS04—see figure two for correct location of the sockets. Solder-in the capacitor and the diode, making sure the diode is the proper way round; the end with the band should be towards the edge connector.

Then you have to use the wiring schedule mentioned earlier. It does not matter how you route the wires so long as they do not go over the top of

Figure 1



PARTS LIST

1 Vero VQ board
2 Edge connector 2 × 23-way, double-sided—ZX-81, 2 × 28-way, double-sided—Spectrum.
1 0.1 uF capacitor
1 1N914 diode
1 1K resistor
1 74LS04
1 74LS133
1 Dual in-line 14-pin socket
2 Dual in-line 16-pin socket
1 Dual in-line 20-pin socket
Connecting wire
1 Extender card for ZX-81 connector

The extender card is available from Technomatic
The edge connector is available from advertisers specialising in ZX-81 parts.
The remainder should be available from any good component shop.

COST

		£
1	Vero VQ board	1.95
1	Edge connector ZX-81	2.25
1	0.1uF capacitor	0.07
K	KB914 diode	0.04
1	1K resistor	0.02
1	74LS133	0.35
1	74LS373	1.15
1	DIL 14-pin socket	0.11
2	DIL 16-pin socket (at 12p)	0.24
1	DIL 20-pin socket	0.17
1	Extender card	0.25
	Connecting wire	0.30
		6.90

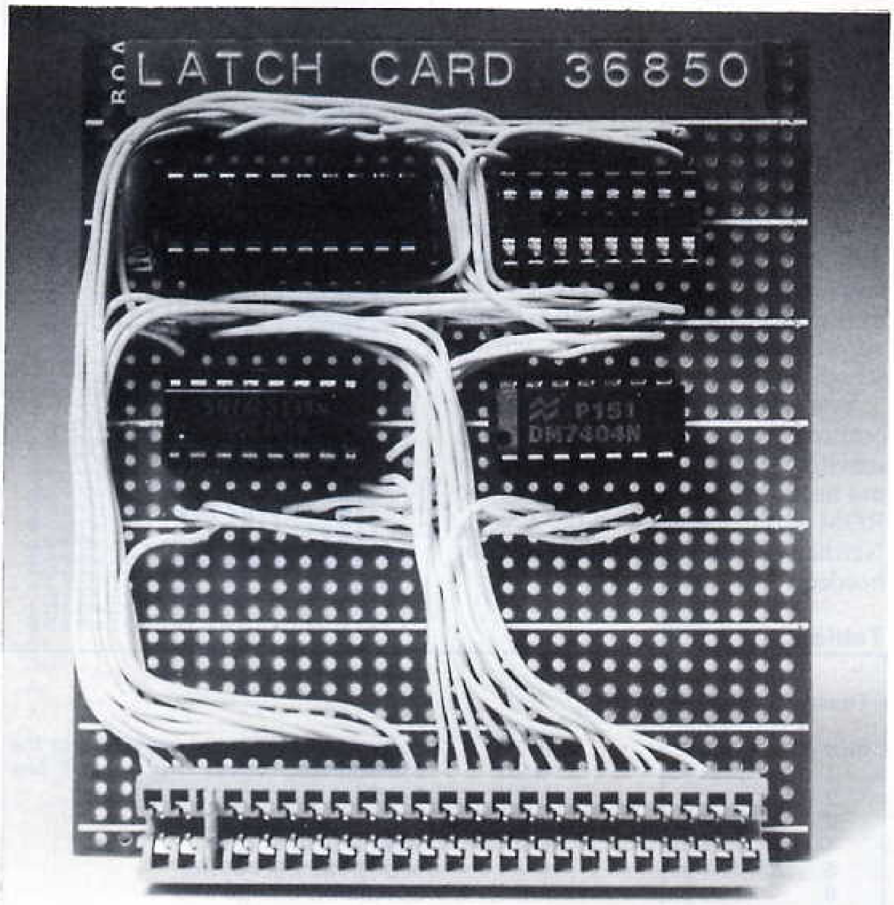
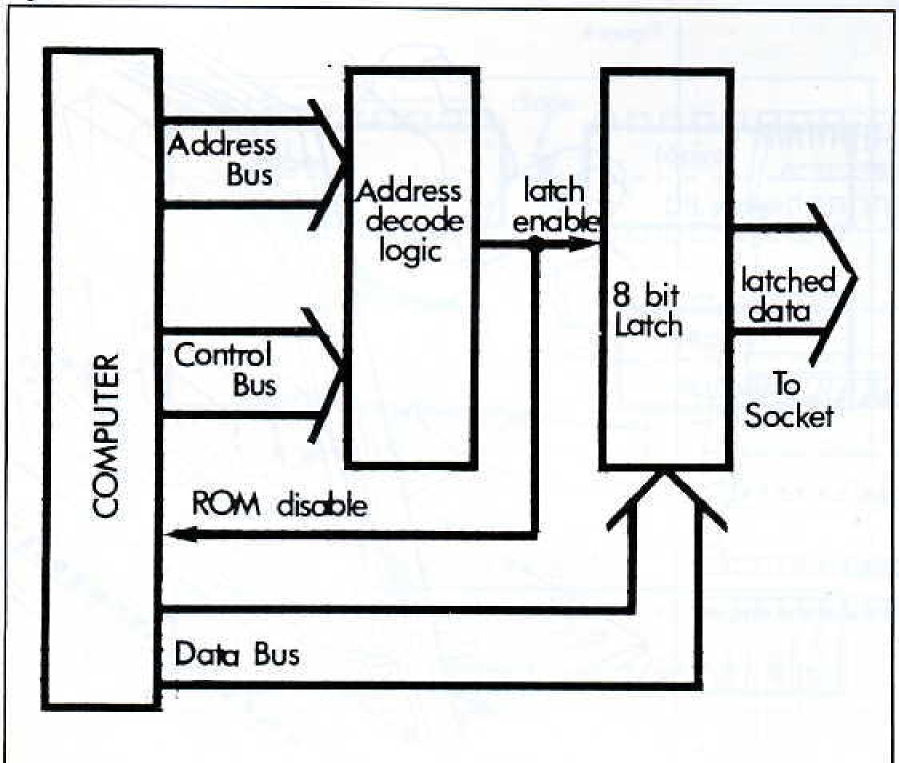


Figure 2



the IC sockets—see photograph for a guide. Start by wiring the 9V pin on the edge connector to pin 10 of the output socket; then the 5V pin on the edge connector to pin 16 of the socket for the 74LS133. Connect that pin to pin 14 of the socket for the 74LS04, then connect it to pin 20 of the socket for the 74LS373 and finally that pin to pin 9 of the output socket.

Then do the same for the 0V pins of the edge connector to the other pins in the same row in the wiring schedule, followed by D7, D0 and so on.

The best way to do the wiring is to strip 1/16in. off one end of the coil of connecting wire, solder it into the Veroboard at the start connection, lay it roughly over the board along where it will be finally and cut it off 1/4in. past the finish connection strip 1/16in. from the end and solder it in. When all the wires have been soldered, they can be pressed and squeezed with the fingers to lay in reasonably neat runs. The resistor is then soldered on the back of the board directly to pins 20 and 11 of the 20-pin socket.

When all that wiring is finished, check the copper side of the board thoroughly for solder splashes, bridged tracks, dry joints and other examples of poor workmanship, and clip off any wires protruding more than 1/16in.—figure three.

Then insert the integrated circuits, making sure you have them the correct way—figure two. You may need to squeeze the pins together gently to be able to fit them into the sockets.

If you are sure everything is correct, unplug the power supply from the ZX-81 plug in the Latch-Card and return the power supply to the ZX-81. The K cursor should still be there and everything should work normally. If it does not, unplug the power supply, unplug the Latch-Card and check each connection for bridged tracks and dry joints.

If you find anything wrong you must have put the wrong wire in the wrong hole; it is very unlikely that the ICs are faulty. Take the chips from the sockets and, with a multimeter set to ohms, check that you

LATCH CARD

have followed the wiring schedule correctly.

The Latch-Card occupies 32 memory locations from 36 × 1,024 – 32 (or 3682) to 36 × 1,024 – 1 (or 36863) and POKEing any one of them will have the same effect. An easy address to remember is 36850. To set all the bits of the latch to logic 0=0V POKE36850,0.

To set bits of the latch to logic 1 = 5V see table one for the value to be POKEd.

The outputs of the 74LS373 can source 10 in mA and so can drive the base of driver transistors directly, e.g., those in the Power-Card.

If you have a 16K Spectrum and wish to have a memory-mapped output latch set by POKEs, the only modifications necessary are to use a longer 2 × 28-way double-sided edge connector, leave off the diode and follow the edge connector signal locations for a Spectrum. An extender card will be more difficult to obtain for a Spectrum.

If you have a 48K Spectrum or wish to have the Latch-Card I/O-mapped set by Basic OUTs, you will have to follow the Spectrum wiring schedule for the I/O-mapped version. The I/O address in that case is not so easily worked-out as for the ZX-81, since any I/O address must have the A0 to A4 address line as logic 1 or the Spectrum does something you may not want. Table two gives a list of I/O locations occupied by the Spectrum Latch-Card as wired according to the Spectrum wiring schedule.

You will note that the diode is omitted from the Spectrum wiring schedule; it is not needed, since it is not necessary to disable a copy of the ROM as one has to do on the ZX-81. Neither is the associated resistor needed.

TABLE 2

```
Spectrum Latch-card
    I.O. address locations

(7*1024)+(0*32)+31=7199
(7*1024)+(1*32)+31=7231
(7*1024)+(2*32)+31=7263
(7*1024)+(3*32)+31=7295
(7*1024)+(4*32)+31=7327
(7*1024)+(5*32)+31=7359
(7*1024)+(6*32)+31=7391
(7*1024)+(7*32)+31=7423
(7*1024)+(8*32)+31=7455
(7*1024)+(9*32)+31=7487
(7*1024)+(10*32)+31=7519
(7*1024)+(11*32)+31=7551
(7*1024)+(12*32)+31=7583
(7*1024)+(13*32)+31=7615
(7*1024)+(14*32)+31=7647
(7*1024)+(15*32)+31=7679
(7*1024)+(16*32)+31=7711
(7*1024)+(17*32)+31=7743
(7*1024)+(18*32)+31=7775
(7*1024)+(19*32)+31=7807
(7*1024)+(20*32)+31=7839
(7*1024)+(21*32)+31=7871
(7*1024)+(22*32)+31=7903
(7*1024)+(23*32)+31=7935
(7*1024)+(24*32)+31=7967
(7*1024)+(25*32)+31=7999
(7*1024)+(26*32)+31=8031
(7*1024)+(27*32)+31=8063
(7*1024)+(28*32)+31=8095
(7*1024)+(29*32)+31=8127
(7*1024)+(30*32)+31=8159
(7*1024)+(31*32)+31=8191
```

Table 1

To set	POKE 36850	
Bit 0	1	(= 2^0)
1	2	(= 2^1)
2	4	(= 2^2)
3	8	(= 2^3)
4	16	(= 2^4)
5	32	(= 2^5)
6	64	(= 2^6)
7	128	(= 2^7)

To set any combination of bits, add the corresponding values, e.g., to set bits 2 and 5.

POKE 36850, (4+32)
or OUT 7999, (4+32) for Spectrum I/O version.

Figure 3

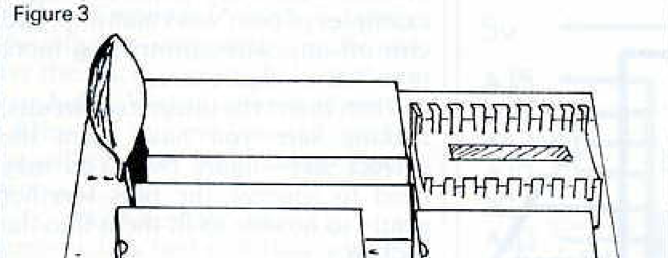


Figure 4

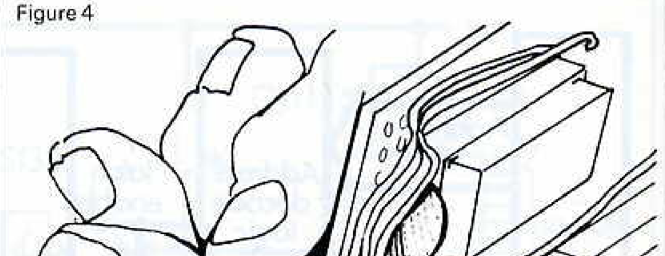


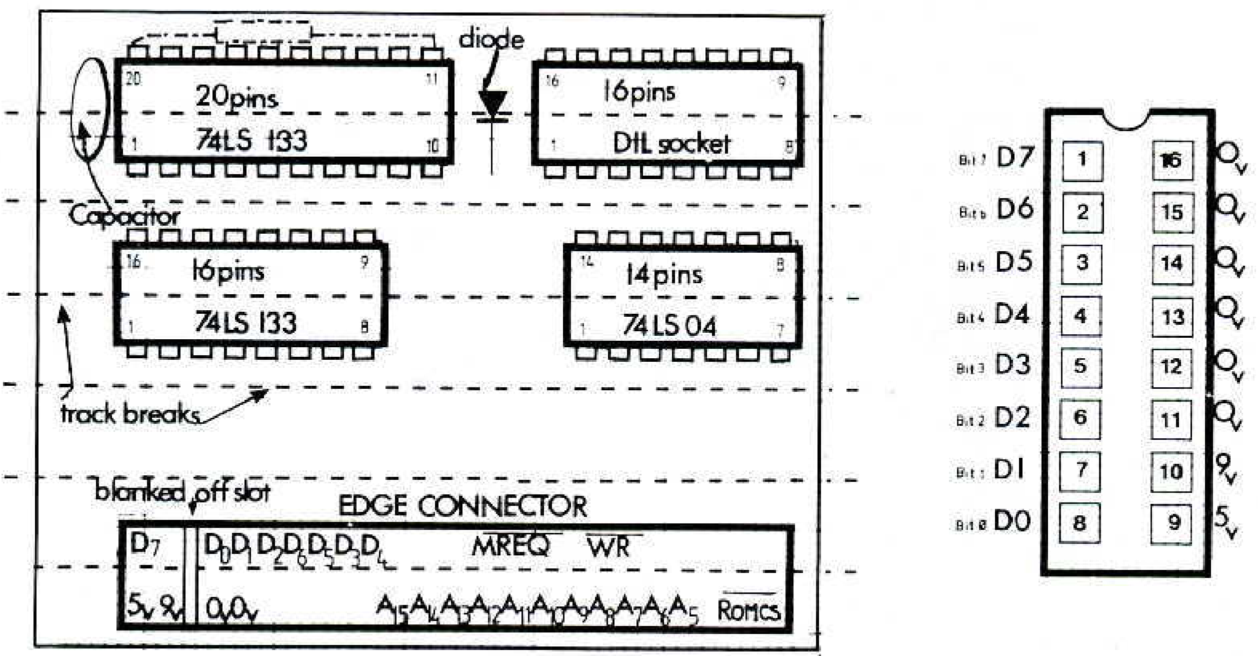
Table 3
Spectrum wiring Schedule (I/O mapped)

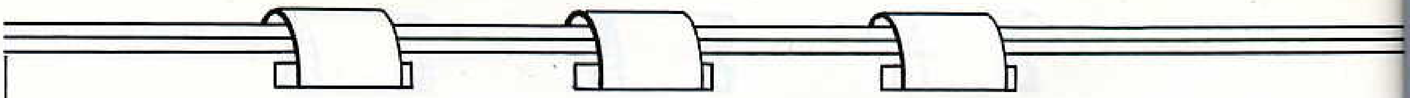
Edge connector	74LS133	74LS04	74LS373	Socket
0v	8	7	1,10	11-16
9v				10
5v	16	14	20	9
D_7			18	
D_0			8	
D_1			7	
D_2			4	
D_6			17	
D_5			14	
D_3			3	
D_4			13	
			19	1
			16	2
			15	3
			12	4
			9	8
			6	7
			5	6
			2	5
$\overline{IOREQ}$		5		
$\overline{WR}$		3		
A_{15}		1		
A_{14}		11		
A_{13}		9		
A_{12}	6			
A_{11}	7			
A_{10}	10			
A_4	11			
A_3	12			
A_2	13			
A_1	14			
A_0	15			
	2	6		
	1	4		
	3	2		
	4	10		
	5	8		
	9	13		
		12	11	

Table 4
ZX-81 and Spectrum wiring schedule (Memory-mapped)

Edge connector	74LS133	74LS04	74LS373	Socket	Diode
D_7			18		
D_0			8		
D_1			7		
D_2			4		
D_6			17		
D_5			14		
D_3			3		
D_4			13		
			19	1	
			16	2	
			15	3	
			12	4	
			9	8	
			6	7	
			5	6	
			2	5	
A_{14}		11			
A_{13}		9			
A_{12}		1			
A_{11}	7				
A_{10}	10				
		12	11		N
	9	15			
	6	2			
	1	4			
	2	6			
	5	8			
	4	10			
A_{15}					
A_9					
A_8					
A_7					
A_6					
A_5					
$\overline{MREQ}$		5			
$\overline{WR}$		3			
$\overline{ROMCS}$					P
9v				10	
5v	16	14	20	9	
0v	8	7	1,10	11-16	

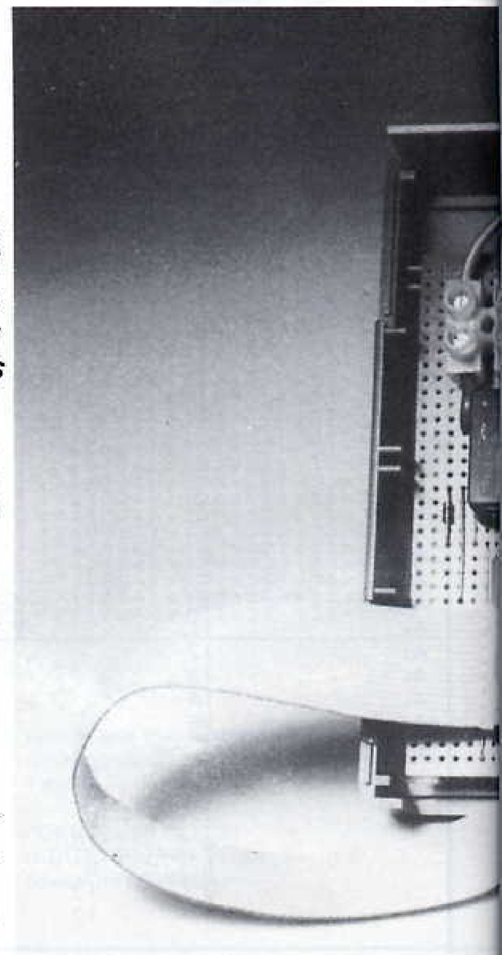
Figure 5





Brightening the festive season

Dave Buckley details how to improve your Christmas tree decorations by making a simple power card which will allow your ZX-81 to control the switching on and off of the tree lights. The card can also be used for a number of other switching applications, including lamps, aquarium heaters and model railway points.



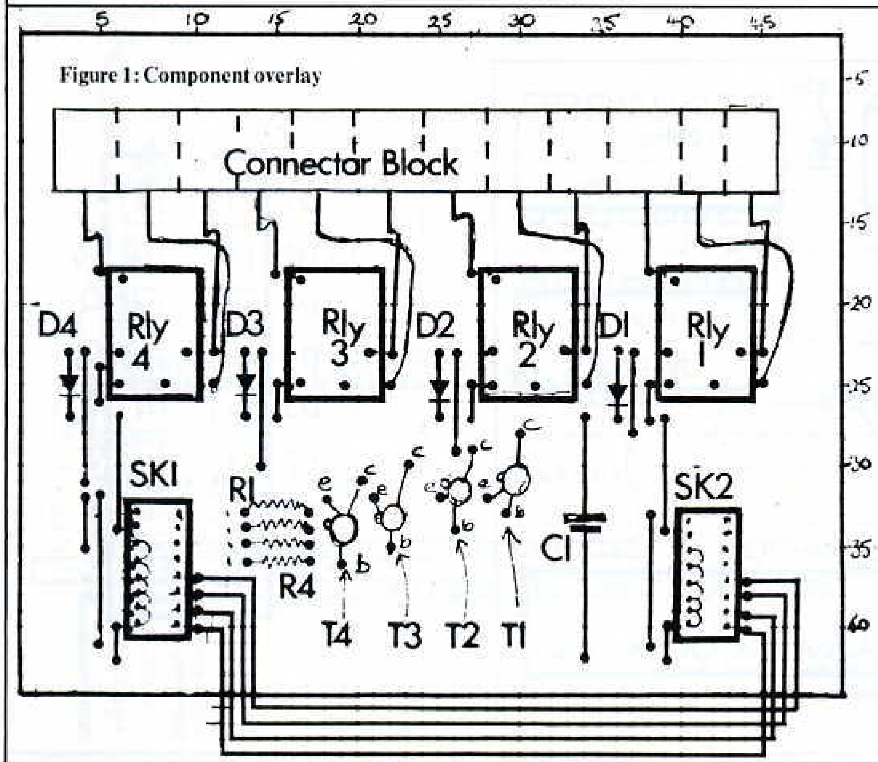
THIS IS a simple, low-cost project to permit you to switch on and off under program control up to four 5 amp loads at up to mains voltages, although because of the limitations of the connectors used the total of the four loads should not exceed 5 amps.

The Power-Card is controlled via any user output port such as the Latch-Card. It is designed to be plugged straight into the Latch-Card.

Suitable applications for the Power-Card include switching lamps, aquarium heaters, electric motors and model railway points. The warning is that it should not be used to switch unattended room heaters or electric fires. If you build it in time, you can dazzle and amaze your friends and neighbours by using your ZX-81 or Spectrum to control your Christmas tree lights. Used with an add-on sound board, you could even have your lights flash in time with music, such as Christmas carols.

You will see that the circuit board has been mounted in a stout plastic Verobox; that is essential if the Power-Card is to be used to switch mains voltages. On the other hand, if you are to use it only to control your model trains, the box can be omitted and the cost of the project will be almost halved.

Figure 1: Component overlay



COMPONENTS

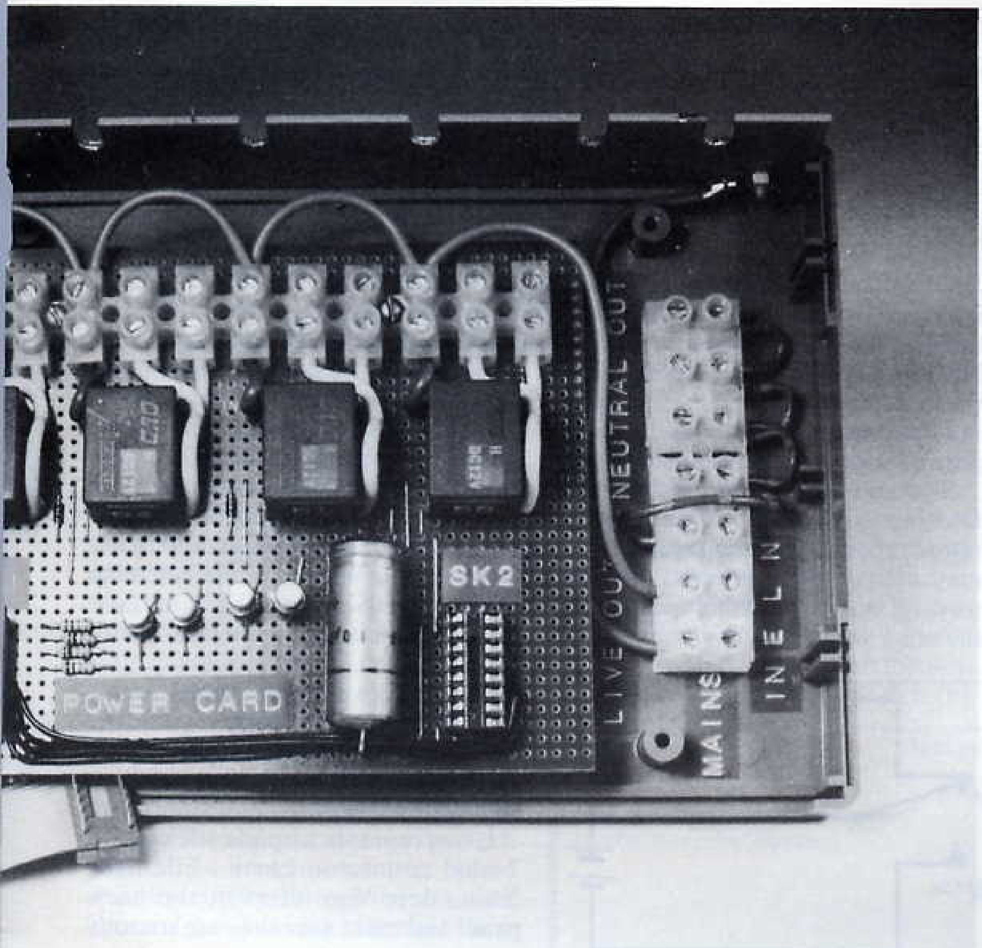
Qty	*Item*
2	16-pin dual in-line socket—SK1, SK2
1	Veroboard 3¾in. x 5in. (10347)
4	10 amp change-over 12V coil relays—Rly1 . . . Rly4 Maplin (10 amp mains relay—VX97F)
4	BC107B transistors—T_1 . . . T_4
4	1 Kohm resistor—R_1 . . . R_4
4	1N914 diode—D_1 . . . D_4
1	100m 16V capacitor—C
1	6BA solder tag
1	12-way connector block (5 amp rating)
1	7-way connector block (5 amp rating)
1	Vero case 202-21037L type 214 180mm. x 120mm. x 40mm. connecting wire

All the components can be obtained from Maplin.

To connect the Power-Card to a user port you need either two 16-pin dual in-line header plugs and one 1ft. 16-way ribbon cable or one 16-pin DIL plug to 16-pin plug cable assembly. The header plugs and ribbon cable should be available from any good component shop.

The case assembly is available from Technomatic and other computer component shops.

CHRISTMAS LIGHTS



The Power-Card is built on a standard-sized piece of Veroboard. Insert the big components in the correct place in the Veroboard using the component overlay diagram—figure one—as a guide, and solder them in place. Then work your way down to the small components; it is easier to have the locations correct that way.

When all the components have been soldered in place and the excess leads have been cropped-off, use a 1/8in. twist drill held in your fingers or a Vero trackbreaker to cut the tracks in the places indicated. Although this is the opposite way of constructing things from that usually recommended, if the tracks are cut before fitting there is great difficulty in finding the correct locations.

Having fitted all the components, mount the 12-way connector block using two 6BA nuts and bolts or stick it down using sticky pads. When it is in place, use thick insulated wire to put in the links between the connector block and the relays. Use blue for the common connectors, yellow for the normally-closed ones and white for the normally-open connection on each relay.

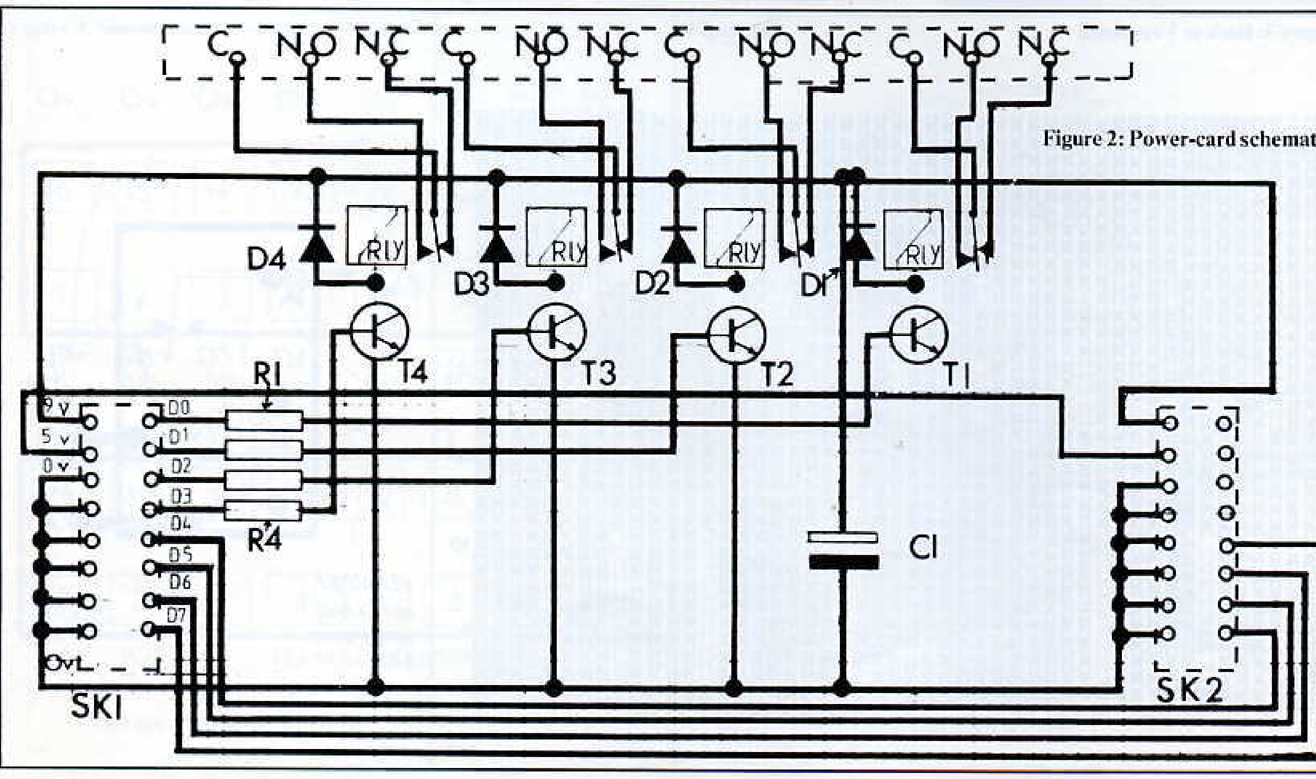


Figure 2: Power-card schematic

CHRISTMAS LIGHTS

Where the links enter the Veroboard, make sure that there is a good solder connection between the link and the relay connection. For the normally-open connection (white) lay an offcut of component wire along the Verotrack between the white link and the relay connection and solder it in place to give a good, thick connection. Vero-tracks by themselves will burn-out if you try to put 5 amps through them.

The Power-Card uses only the lowest four bits of the output latch and so you can use the upper four bits to control something else. If the unused upper four bits is routed along with the 9V, 5V and 0V lines to SK2, you can plug-in something else there—perhaps another Power-Card—but in that case it would be advisable to route the unused upper four bits to the lower four bit positions of SK2 and then the second Power-Card should be identical to the first; otherwise on the second card the four base resistors would need to go to bits 3 to 7, rather than bits 0 to 3.

If you do not want to use the upper four bits, you can omit SK2 and its interconnecting wires. One point you may notice—SK1 and SK2 are one way round in the photograph and the other way round on the drawings. The drawings are correct. Having assembled all the circuit board, there must be some way of holding it in the box. A piece of 3/8in. balsa, 1in. × 5in., can be stuck, using sticky pads, to the Veroboard under the connector block. That gives support for when you are connecting wires to the Power-Card. Also you could stick 1/4 × 1in. pieces of 3/8in. balsa underneath SK1 and SK2 to give them some support, again using sticky pads.

If you are to use the Power-Card to switch only low voltages you can leave it at that but for mains the box is needed, with the balsa feet stuck to the inside of the box.

Using more sticky pads, stick in the 7-way connector block. File five 3/16in. slots 1/2in. deep in the back panel and make sure they are smooth

Figure 5: Model motor control

Motor on/off using one relay

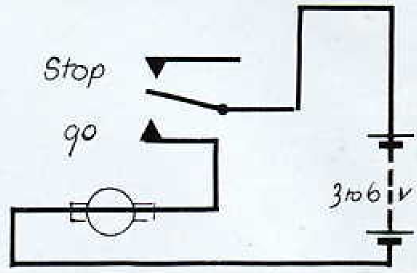


Figure 6

motor forward/reverse using one relay

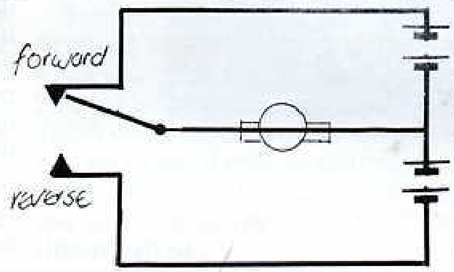


Figure 3: Back or Veroboard

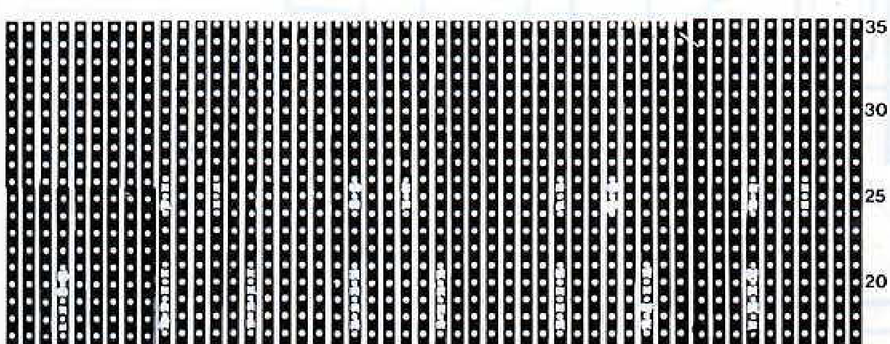
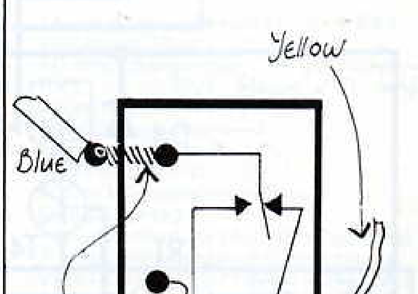


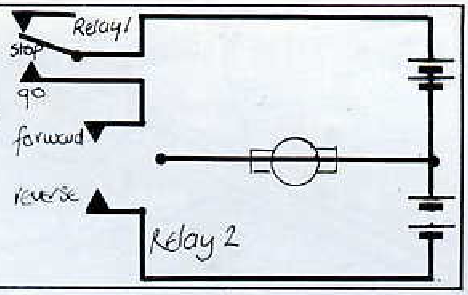
Figure 4: Relay power connections



CHRISTMAS LIGHTS

Figure 7

motor forward/reverse/stop using two relays



and then attach a solder tag with a 6BA nut and bolt. Then cut a slot in the left-hand side of the top of the box (by SK1) for the input to SK1—see figure six.

The box wiring is shown in figure seven and it should be done in thick wire which will carry 5 amps. Then the mains supply wires can be wired into the three connectors marked Mains In, Earth, Live and Neutral. The four loads can each be wired between one of the neutral out connectors and one of the four NO—normally open—connectors by relays.

To prevent putting any strain on the connectors by the wires leaving the box through the slots in the back panel, tie a knot in each lead before and after it goes through the slot—see figure eight—making sure that there is slack on the inside of the box.

Nothing could be easier to operate. Attach the 16-pin DIL jumper cable between SK1 and the Latch-Card or some other 8-bit output port, making sure that the orientation of the plugs is correct. If some other 8-bit output port is used, you must make sure that the various signals and power lines have been transposed to suit SK1.

Writing zero to the port will turn-off all the loads and writing a 1 to any of the low-order data bits will turn-on that particular relay, e.g., POKE the port with 1 will turn on relay 1, POKE with 2 will turn on relay 2, POKE with 3 and both relay 1 and relay 2 will be turned-on.

The Power-Card will control small DC model motors easily but when that is being done the Power-Card must not be connected to the mains. Figure 10 gives details.

Here is a sample program to drive Power-Card using a ZX-81 and the Latch-Card:

```
10 REM ASSIGN PORT ADDRESS TO P
20 LET P=36850
30 REM ASSIGN MAXIMUM PAUSE TIME TO T
40 LET T=100
50 REM RANDOMLY SWITCH EACH RELAY
60 REM AT RANDOM TIMES
70 POKE P,RND*15
80 PAUSE 1+T*RND
90 GOTO 70
```

Figure 8

Alternative method motor forward/reverse/stop using two relays

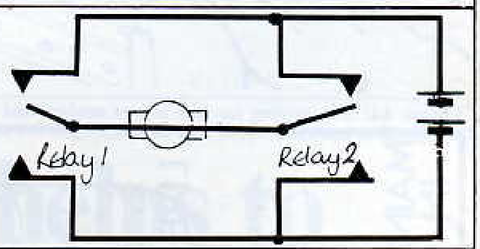
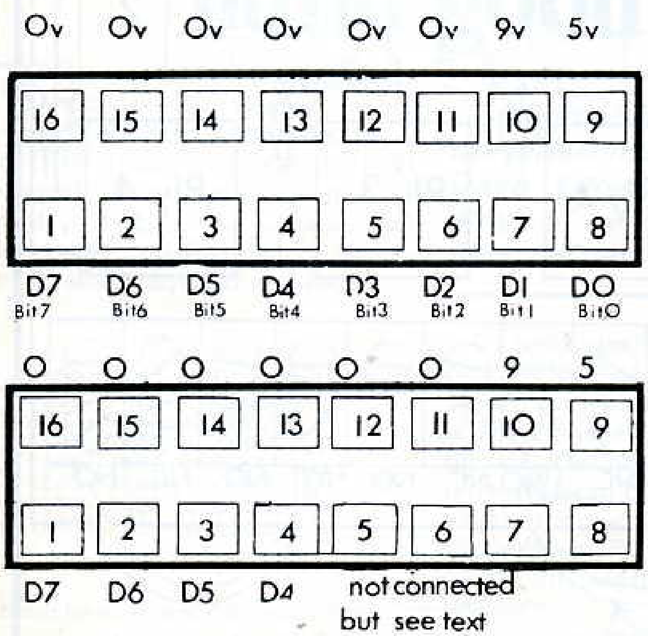
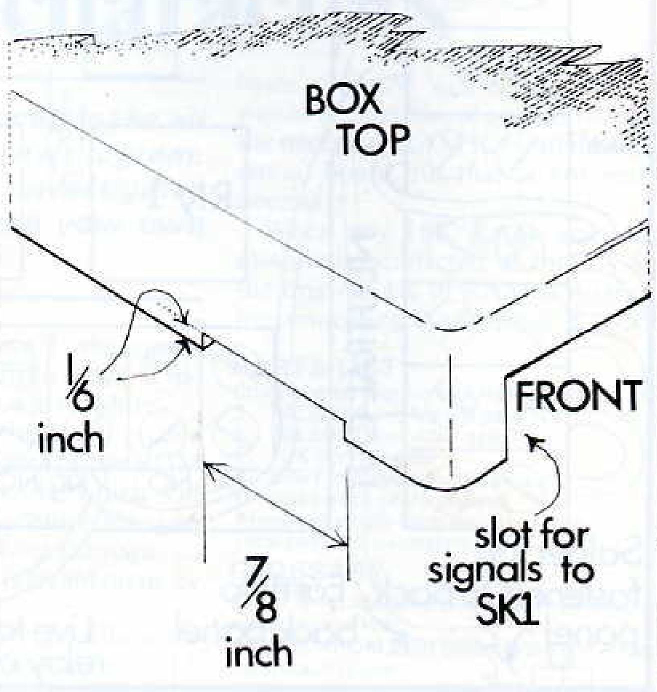


Figure 9: SK1 pin allocation



SK2 pin allocation

Figure 10:



CHRISTMAS LIGHTS

Figure 11: Cutting holes in the Veroboard

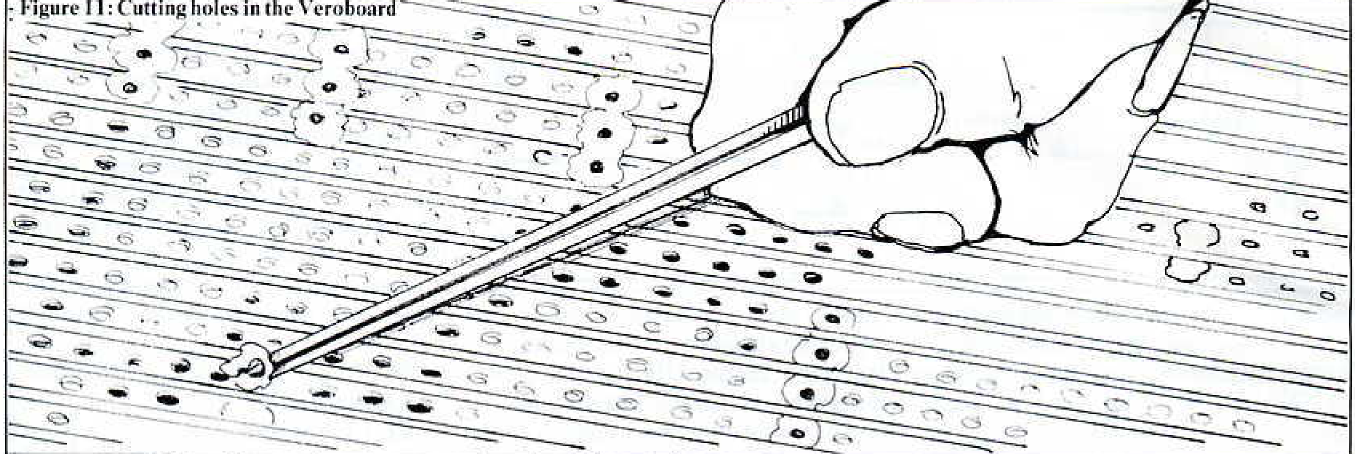


Figure 12: Soldering relays onto boards

Figure 13

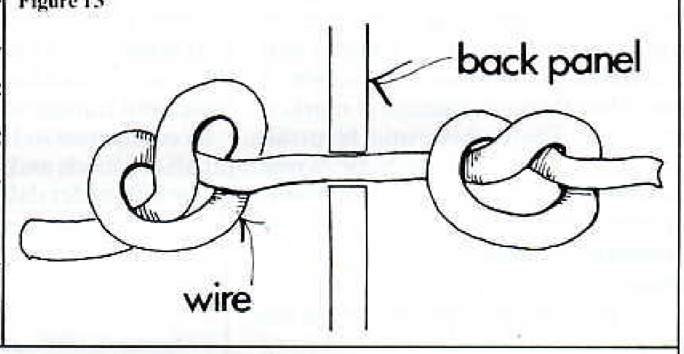
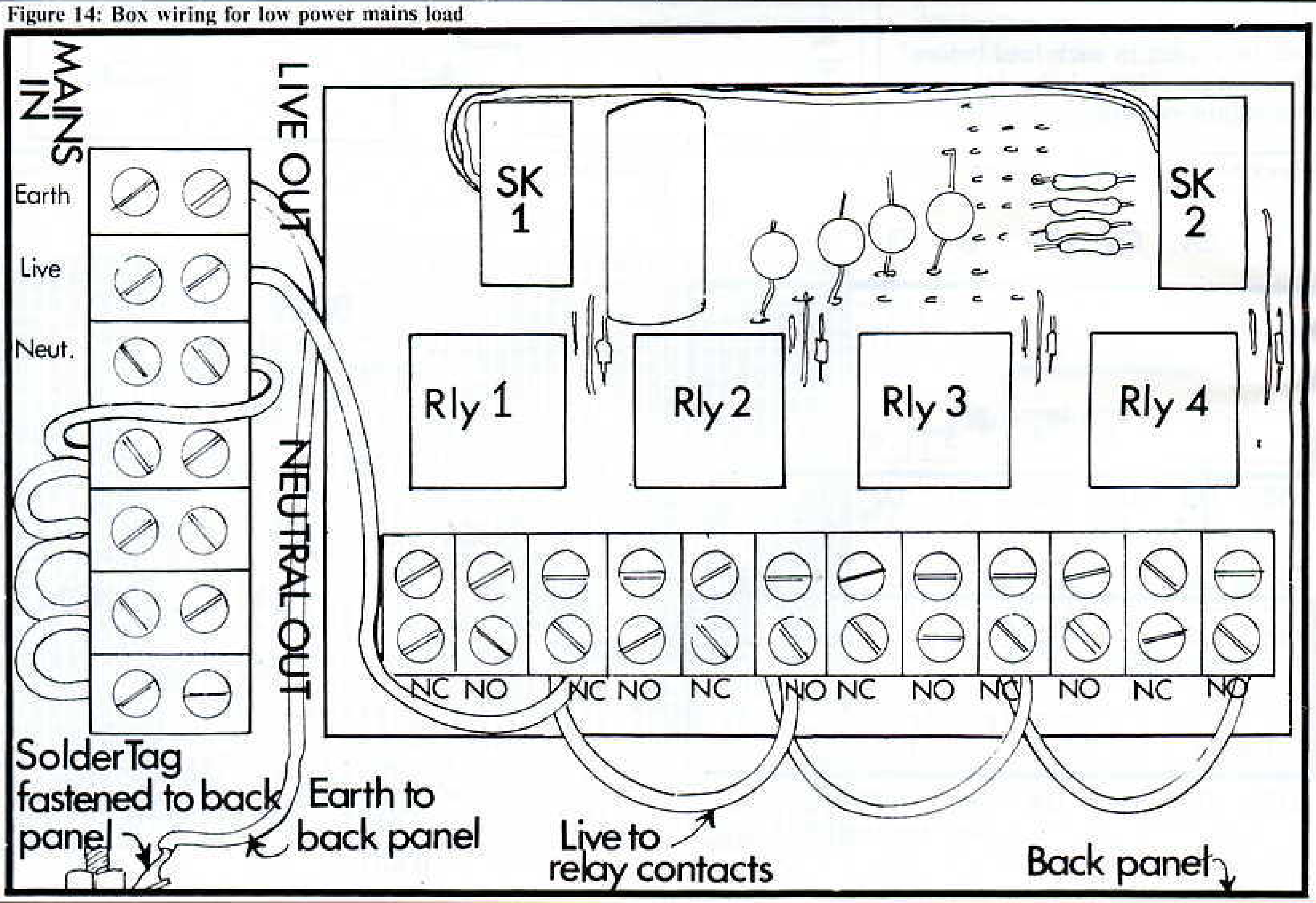


Figure 14: Box wiring for low power mains load



GRAPHICS GENERATOR

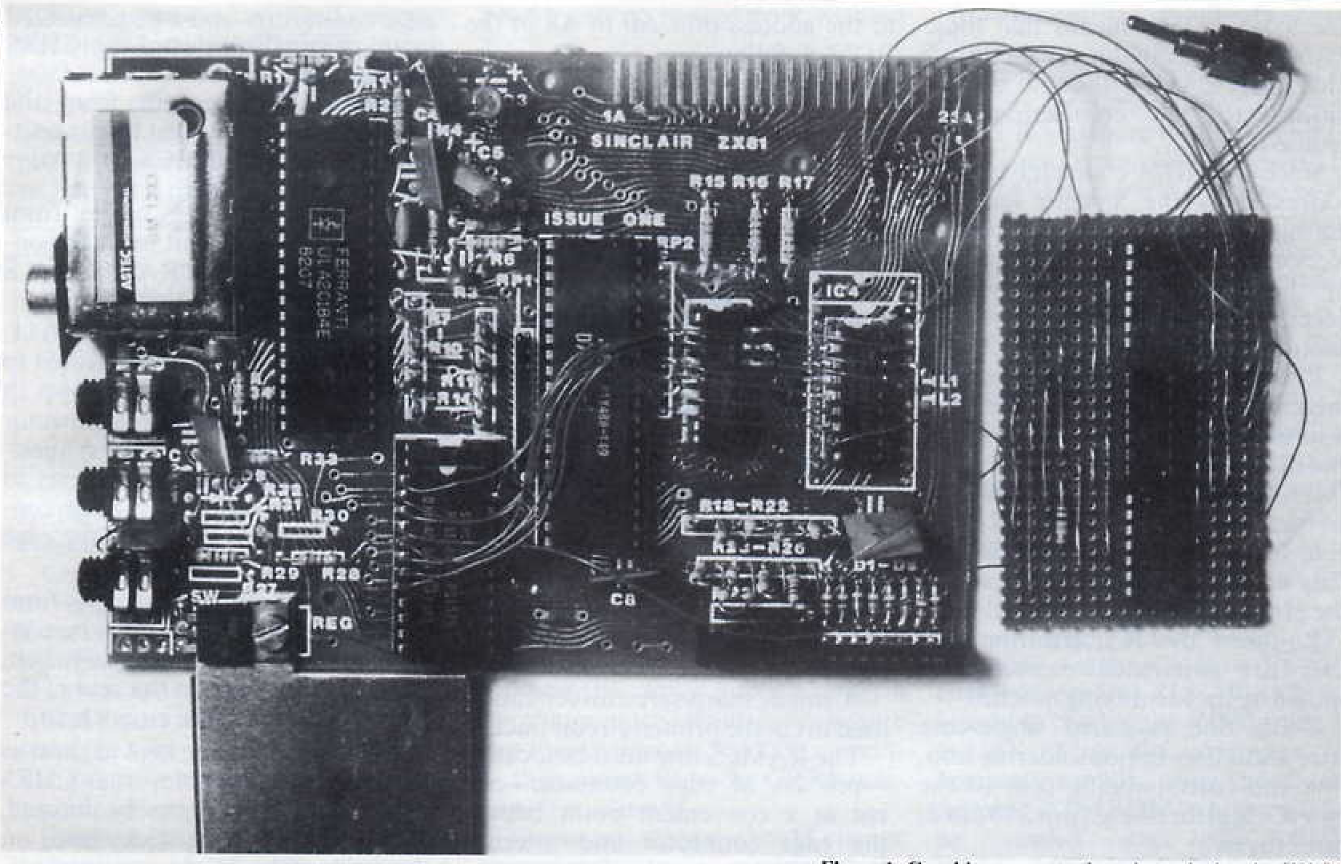


Figure 1: Graphics generator board attached to the ZX-81

Circuit training helps to build good characters

Good graphics can make all the difference to a program. Dave Looker investigates ways of defining your own illustrations.

THE CHARACTER table—dot patterns—are located in the ZX-81 ROM from 1E00 (hex), to 1FFF (hex), i.e., 7680 to 8191 decimal. Each character requires eight bytes — consecutive addresses—to define the dot pattern for the shape required, as shown:

```
1E00- 7680- 00000000
1E01- 7681- 00000000
1E02- 7682- 00000000
1E03- 7683- 00000000
1E04- 7684- 00000000
1E05- 7685- 00000000
1E06- 7686- 00000000
1E07- 7687- 00000000
```

Space Character code: 0 decimal, 00 hex.

If a particular bit is a '1', the corresponding location will be black; if the bit is '0' the location will be white.

The circuit described will enable the character table area of the ROM to be replaced by RAM, which will enable the user to define his own characters by POKEing the required bit patterns into the relevant memory locations.

To accommodate the character dot-pattern table, a minimum of 512 bytes of RAM will be required. It would be possible, of course, to build the necessary RAM ICs into the logic circuit board but that is not really necessary.

When any 16K RAM extension module is connected to the ZX-81, the original 1K of RAM is disabled by connecting the internal $\overline{\text{RAMCS}}$

PARTS LIST

Components required for this project are:
- 2 74LS00 Quad NAND gate ICs
- 1 74LS08 Quad AND gate IC
- 1 10K ¼W resistor
- 1 SPST miniature toggle switch
- 1 small piece of Veroboard
- 1 metre of single-core insulated wire

Total cost approximately £2

GLOSSARY

$\overline{\text{RAMCS}}$—RAM Chip Select—the line above means active low.
$\overline{\text{ROMCS}}$—ROM Chip Select—the line above means active low.

line to +5V. That means that these RAM ICs are available for use as our Characters RAM, with some modifications to the connections, as detailed.

Since the ROM character table is addressed by the Sinclair logic IC during the Display Refresh Interrupt section of the machine cycle, and not by the Z-80 processor, it will be necessary to modify the address connections to the RAM ICs.

Remove the 2114 RAM ICs from their sockets, taking note of the position of the identifying notch in the end of each IC.

Using a pair of tweezers, bend the address pins A0 to A8—pins 2, 3, 4, 5, 6, 7, 15, 16 and 17—upwards until they are at right angles to the rest of the pins.

Re-insert the ICs, ensuring that they are orientated correctly, as shown by the identifying notches.

Using fine insulated single-core wire and a fine-tipped soldering iron, link the corresponding pins of the two ICs together—e.g., pin 2 to pin 2, pin 3 to pin 3.

Using the same fine wire, connect the address pins of the two RAM ICs to the address pins A0 to A8 of the ROM, as follows:

RAM IC pins	ROM IC pin	Address line
2	23	A8
3	1	A7
4	2	A6
17	3	A5
5	4	A4
16	5	A3
6	6	A2
15	7	A1
7	8	A0

It is not necessary to re-connect the A9 terminals of the RAM ICs (pin 1) to the ROM A9 terminal, since this is a direct connection already.

Having constructed the CHR$ logic circuit on Veroboard as shown in the diagram, proceed with the connections as follows:

The $\overline{\text{ROMCS}}$ line must be located—pin 23B of ZX-81 edge connector—and CUT at a convenient point between the edge connector and the ROM.

A small, sharp screwdriver can be used to cut the printed circuit track.

The $\overline{\text{RAMCS}}$ line must be located—pin 2A of edge connector—and cut at a convenient point betwen the edge connector and internal. RAM ICs.

The $\overline{\text{ROMCS}}$ line—pin 23B of edge connector—must be connected to the $\overline{\text{ROMCS}}$ input of the CHR$ logic circuit.

The $\overline{\text{ROMCS}}$ output from the CHR$ logic circuit must be connected to the ROM $\overline{\text{ROMCS}}$ terminal—pin 20 of the ROM IC.

The CHR$ $\overline{\text{RAMCS}}$ output from the CHR$ logic circuit must be connected to the internal RAM $\overline{\text{RAMCS}}$ terminals—pin 8 of either RAM IC.

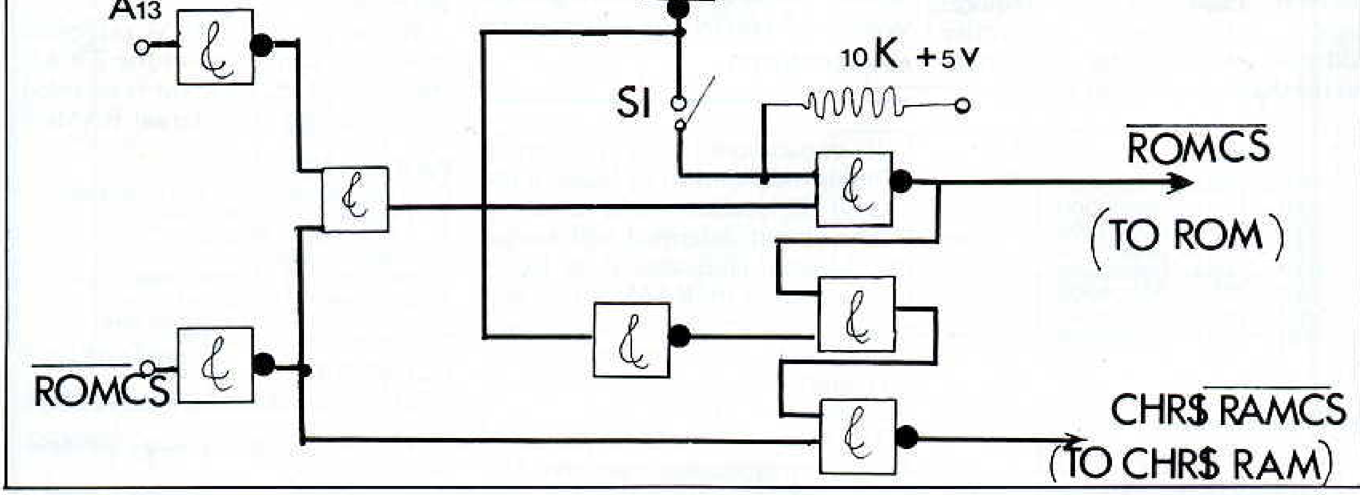
The address lines A9, A10, A11, A12 and A13 must be connected to the CHR$ logic circuit as shown in the diagram. See edge connector diagram for location of address lines.

The +5V and 0V connections to the CHR$ logic circuit must be connected to pins 1B and 4B of the edge connector respectively.

The switch (S1) connections from the CHR$ logic circuit must be connected to the miniature toggle switch, which can be fitted in the rear of the ZX-81 case, above the circuit board.

All leads should be kept as short as conveniently possible; the CHR$ logic circuit board can be located, with a self-adhesive sticky pad, on the inside of the ZX-81 case, immediately above the Z-80 CPU IC.

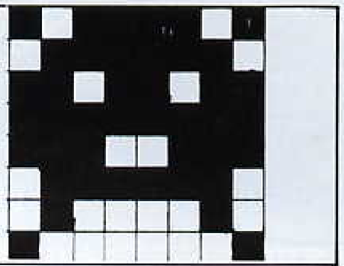
Figure 2: Logic circuit



Take great care with all connections to avoid shorts between circuit tracks; in particular, connections to the pins of ICs should be made as quickly as possible; do not heat the pin for more than two or three seconds at a time, otherwise damage to the IC may occur because of excessive heat.

Figure 3:

Binary code	Hex code	Decimal
10111101	BD	189
01111110	7E	126
11011011	DB	219
11111111	FF	255
11100111	E7	231
01111110	7E	126
01000010	42	66
10000001	81	129



Check that all connections are correct and that no shorts are present; if everything seems satisfactory you are ready for the initial test of the circuit, as follows:

Make sure that the switch S1 is open, i.e., in the normal position. The purpose of this instruction will become apparent later.

Connect your ZX-81 to the TV set and power supply in the usual way; plug-in the 16K RAM pack. The ZX-81 will no longer work without it.

Switch on the power to the ZX-81. If the cursor fails to appear within the usual time, or the display goes into a crash state, switch-off immediately and re-check all the connections. It is unlikely that any permanent damage could be caused by incorrect connections; having located and corrected any errors in the wiring, the circuit should then work correctly.

When the cursor appears, enter a few commands or letters to make sure that the keyboard is working correctly, then switch S1 to the CHR$ position—i.e., close S1.

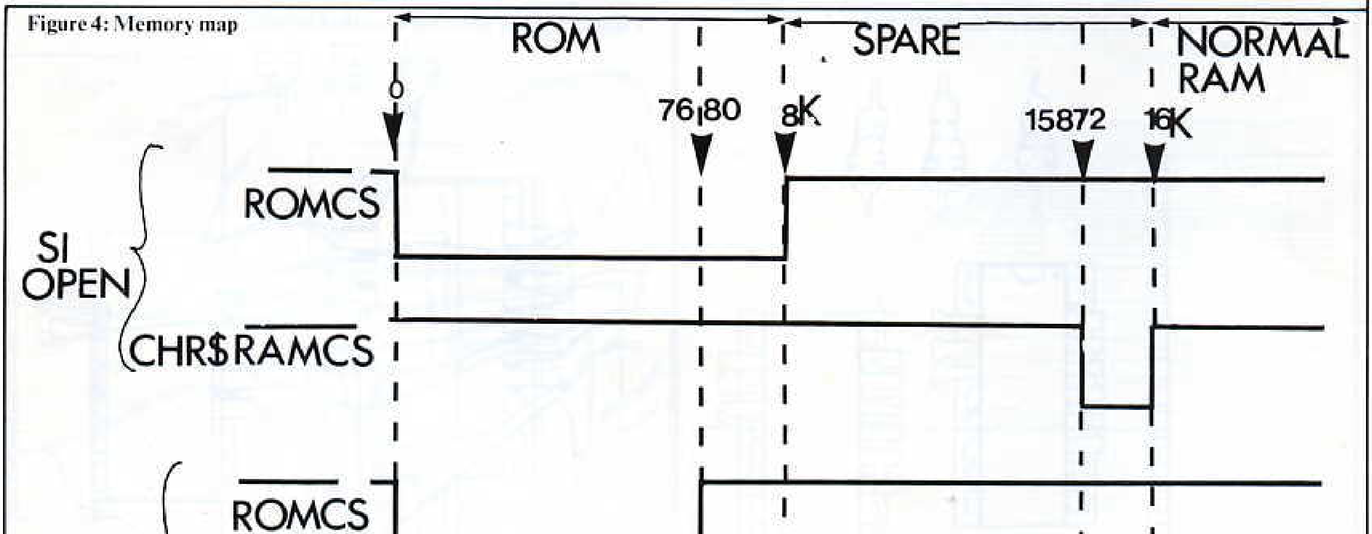
The screen display should change immediately to a random high-resolution pattern, with any characters becoming randomly-shaped blobs.

The reason for this effect is that the memory locations in the 2114 static RAM ICs assume random values at power-up; when S1 is closed, the ROM CHR$ table is replaced by the CHR$ RAM which, at present, contains random data, hence the screen display will be random garbage. When S1 is opened, i.e., switched back to the normal position, the display will revert to normal.

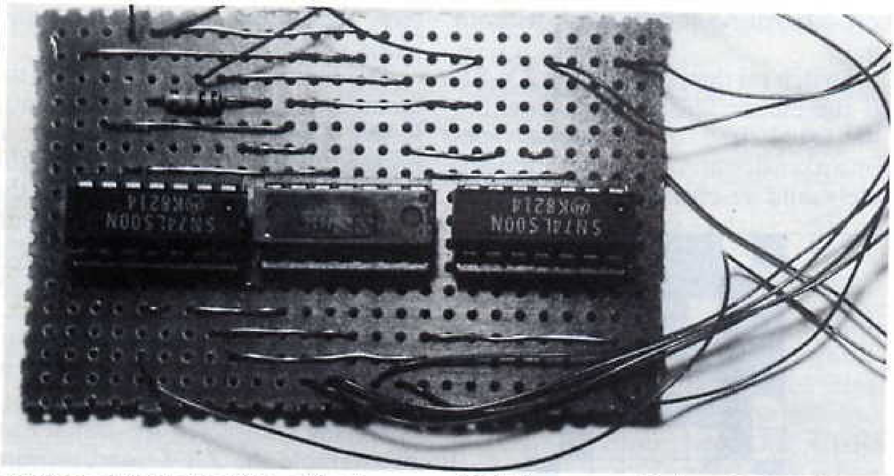
Having completed the initial test, re-assemble the ZX-81 and proceed to the initialisation routine in the next section.

For circuit operation and initialisation, with S1 open, the 'ANDED' combination of A9, A10, A11 and A12 will enable RAMCS from 15872 to 16383 (decimal), with ROMCS enabled from 0 to 8191 (0-8K); A13 is used to disable the ROM from 8K to 16K. Thus the computer will operate normally, using the character table in the ROM, which can then be copied into the CHR$ RAM—15872 to 16383—either by using a machine-code block-shift

Figure 4: Memory map



GRAPHICS GENERATOR



routine, or by entering a Basic program (a) of the form:

```
1 FAST
5 LET A= 15872
10 FOR M=7680 TO 8191
20 POKE A, PEEK M
30 LET A=A+1
40 NEXT M
50 SLOW
```

This program copies all the CHR$ dot patterns in the ROM character table into the CHR$ RAM positioned at 15872 to 16383 on the memory map—3E00 to 3FFF hex.

Once run, it can be deleted by the NEW command, since NEW will not affect the CHR$ RAM.

With S1 closed, the ROM will be disabled from 7680 to 8191 and the CHR$ RAM will be activated in its place. The CHR$ RAM will also appear at 15872 to 16383 on the memory map, since CHR$ RAMCS will be active-low in this region also.

Having loaded the ROM dot patterns into CHR$ RAM—using program (a)—closing S1 will have no effect on the display but the user can then change any of the characters by POKEing the required values into the relevant memory locations. The character table can be poked in either the 7680 to 8191 section or the 15872 to 16383 section, since the CHR$ RAM appears at both locations when S1 is closed.

The most straightforward way of defining your new character is, first, draw your desired character—preferably on graph paper and write the binary code corresponding to each line, as shown in the example—figure three.

Having worked-out the required binary codes, an easy method of conversion to hex code can be employed, using this table:

Binary	Hex
0000	0
0001	1
0010	2
0011	3
0100	4
0101	5
0110	6
0111	7
1000	8
1001	9
1010	A
1011	B
1100	C
1101	D
1110	E
1111	F

Divide the 8-bit code into two 4r-bit sections and look up at the hex code for each half in the table. The hex equivalent of the 8-bit code is the combination of the hex codes for the two halves:

e.g., 1011 1101
B D

So, 10111101 = BD hex

Using this method, the codes for each of the eight bytes which define the character can be derived as shown for the *Space Invaders* example

Figure 5: Bend pins 2-7, 15-17 and re-insert ICs into sockets

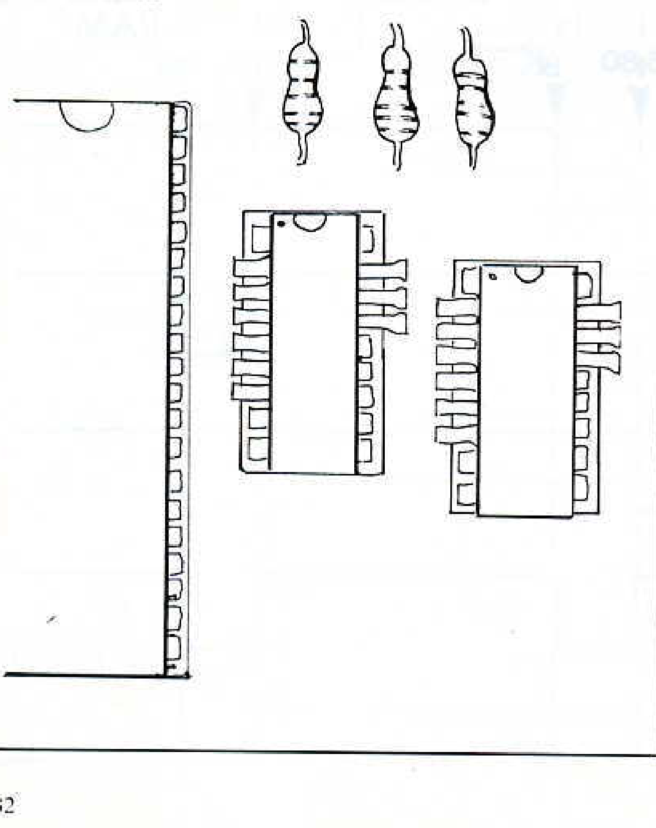
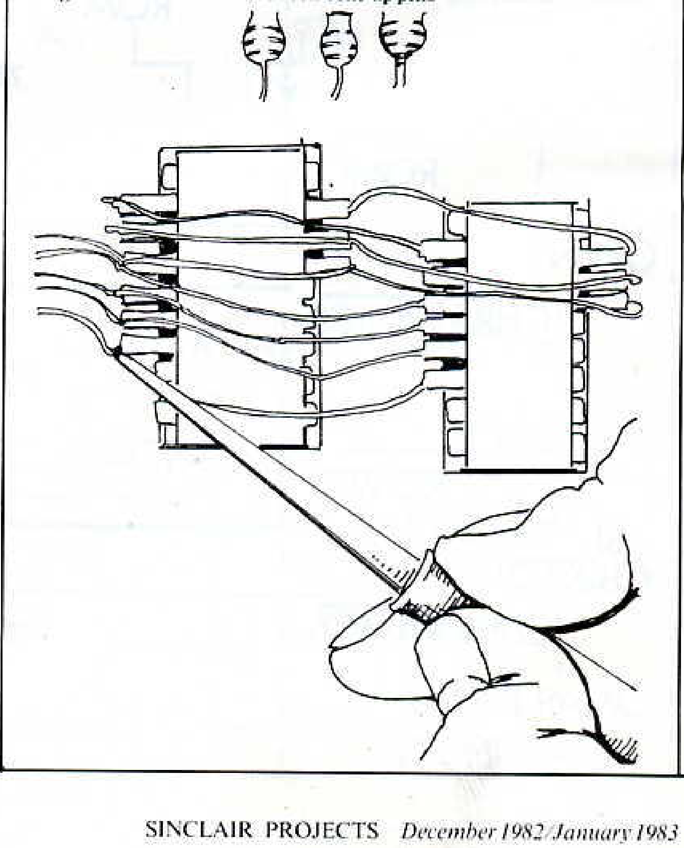


Figure 6: Solder wires between bent-up pins



The next step is to decide which existing character is to be replaced by the new user-defined character. The character code for the character to be re-defined can then be found in appendix A of the ZX-81 user manual. That will be a number between 0 and 63, since the inverse characters are generated automatically by the ROM and will always be the inverse of the characters 0 to 63.

The obvious first choices for characters to be re-defined are the graphics characters—codes 1 to 10—since they will not affect any text content of your program. The following program (b) can be used to re-define any character:

```
10 Print "Input character code (0 to 63)"
20 Input c
30 Print C
40 Print "Input new character Hex Codes"
50 Let M=15872+C*8
60 For N=1 to 8
70 Input H$
80 Poke M, 16 *(code H$ (1)-28) + (Code H$ (2)-28)
90 Print at 21, 0l M; "="; H$
100 Let M=M+1
110 Scroll
120 Next N
```

For example, input '1' in response to the request for a character code and then input the hex codes for the space invader. To test the result, print the graphics '1' character to the screen in the normal way, then close S1. The graphics '1' will change instantly to the space invader.

The NEW command will not affect your new characters, since the CHR$ RAM is located below 16K (16384), which is the start location of the normal RAM area.

```
1 Fast
2 Dim A$(10, 16)
3 Let A$ (1) = "BD 7E DB FF E7
7E 42 81' (space invader example)
4 Let A$(2)="Character hex codes"
5 Let A$(3)="Character hex codes"
6 Let A$(4)="Character hex codes"
7 Let A$(5)="Character hex codes"
8 Let A$(6)="Character hex codes"
9 Let A$(7)="Character hex codes"
10 Let A$(8)="Character hex codes"
11 Let A$(9)="Character hex codes"
12 Let A$(10)="Character hex codes"
13 Let A=15872
14 For M=7680 to 8191
15 Poke A, peek M
16 Let A=A+1
17 Next M
18 For C=1 to 10
19 Let M=15872+C*8
20 For N=1 to 15 step 2
21 Let H$=A$(C, N to N+1)
22 Poke M, 16 *(code H$ (1)-28) + (code H$ (2)-28)
23 Let M=M+1
24 Next N
25 Next C
26 Slow
```

Unfortunately, that also means that the SAVE command will not save your characters either. To save the new characters on to cassette, it will be necessary to find a way of storing the dot-pattern data in the normal program area of RAM.

The easiest way to do so is to store the data in the form of a string—or strings—together with a routine to load the data into the CHR$ RAM before the main program is run. A suitable program (c) would take the following form—see figure nine.

This can be used as a characters initialisation routine at the start of any program in which user-defined graphics are to be used, since it incorporates program (a)—lines 13 to 17—to copy the normal character set into CHR$ RAM before re-defining characters 1 to 10. In fast mode, this routine takes approximately 10 seconds to execute—a small price to pay for the flexibility which is afforded by user-defined graphics.

Figure 7: Connect board to main PCB

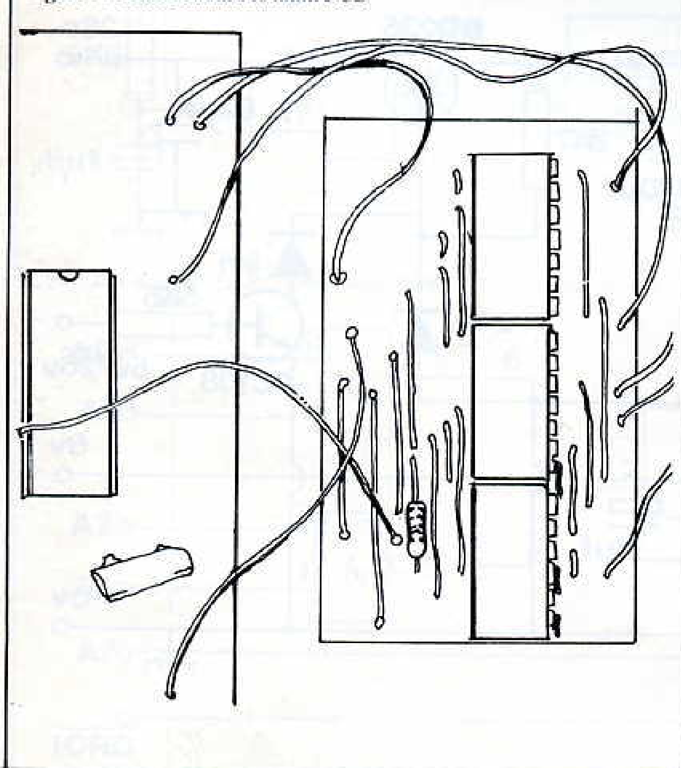
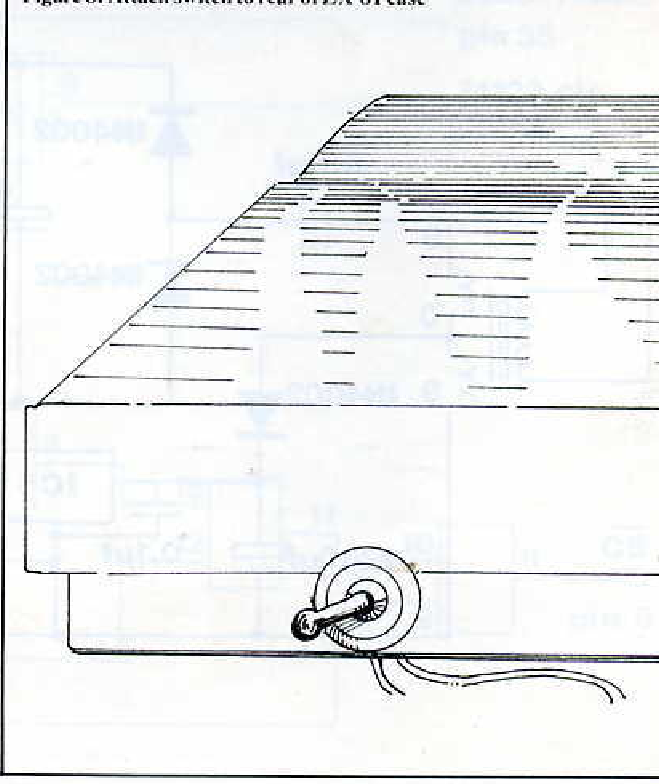


Figure 8: Attach switch to rear of ZX-81 case



EPROM blower needs large software element

Stephen Churchman details how to expand the storage available for programs using inexpensive components.

BECAUSE most users of the ZX-81 are software-orientated, the hardware has been made simple in this design. The software needed to run it consequently will be large and some of it is in machine code.

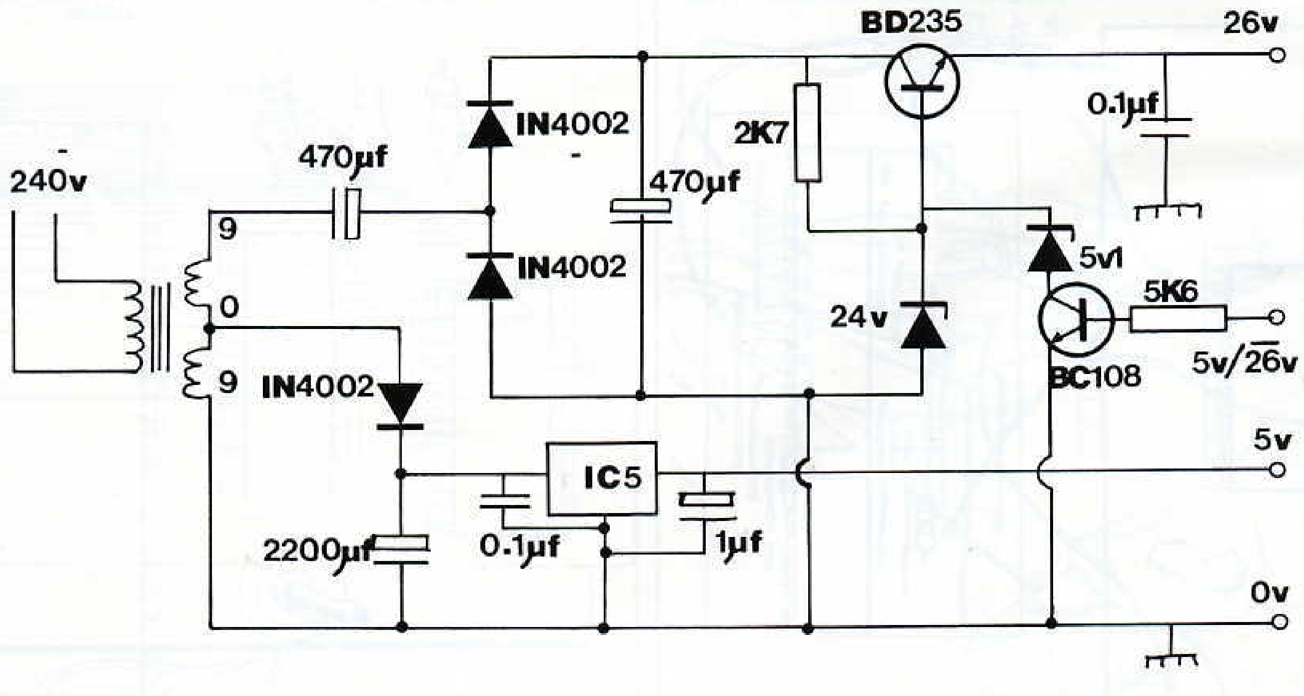
The heart of the design is the 8255 programmable peripheral interface device. This chip has 24 lines of input or output, which can be defined by software. There are only sufficient to handle the 2532 EPROM. Port A is used to output and read the data, port B to output the eight least significant bits and port C for the remaining address bits and control bits. Table one shows which functions port C has for each of the two types of EPROM. The design caters for the 2516 and 2532 EPROMs from Texas Instruments. The 50ms programming pulse is timed by the hardware and PC4 output must return to 0 before 50ms has gone by.

A simple program is included to enable the programming of the EPROM. The machine code routine in the first REM statement will program one memory location and read that memory location. The Basic will call the routine as required. The reason machine code is required is because the 8255 chip is placed in the I/O map of the Z-80 so that the memory map is left alone. In the ZX-81 the PEEK and POKE commands access only the memory map. As Sinclair has not fully decoded the I/O map it was difficult finding somewhere where the 8255 was not affected by the ZX-81.

Another reason for leaving the memory map alone is so that EPROMs can be placed above the 8K ROM. These could contain routines to improve the 8K Basic. Anyone building it is also advised to acquire a data sheet on the 8255, as the chip is very complex.

Referring to the circuit diagrams,

Figure 1:



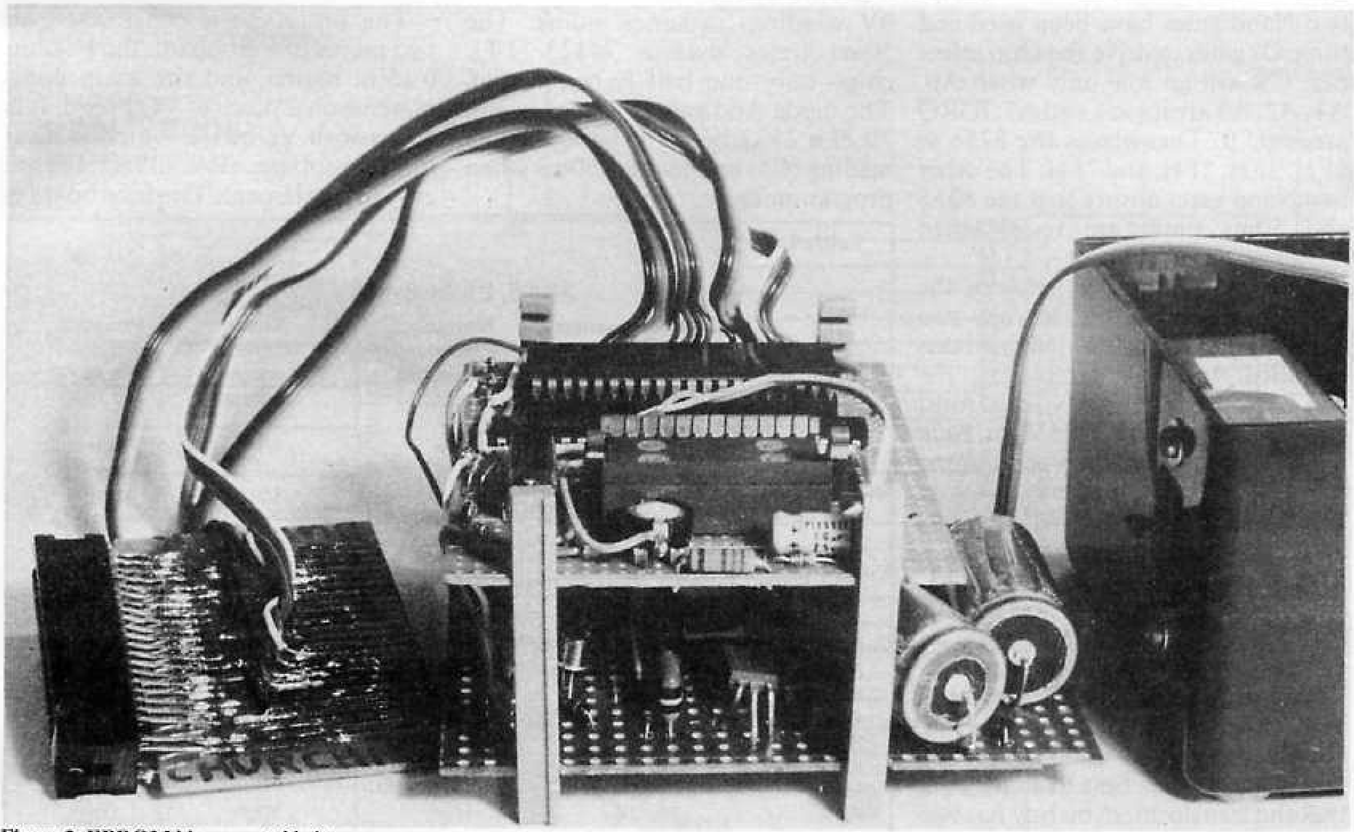
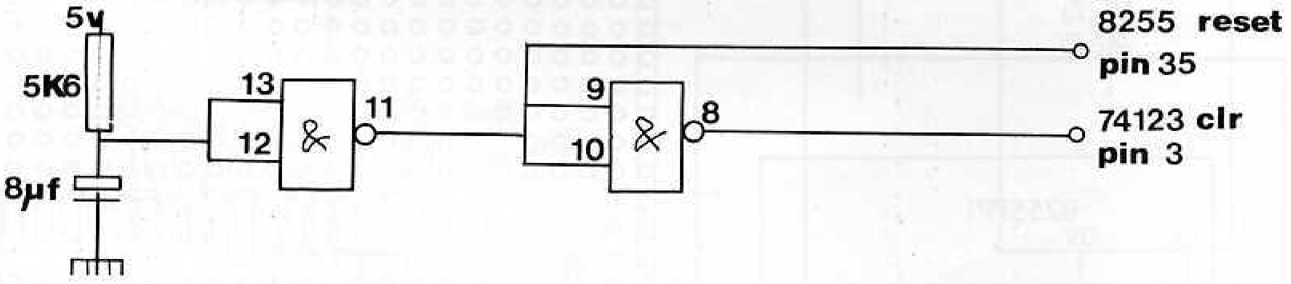
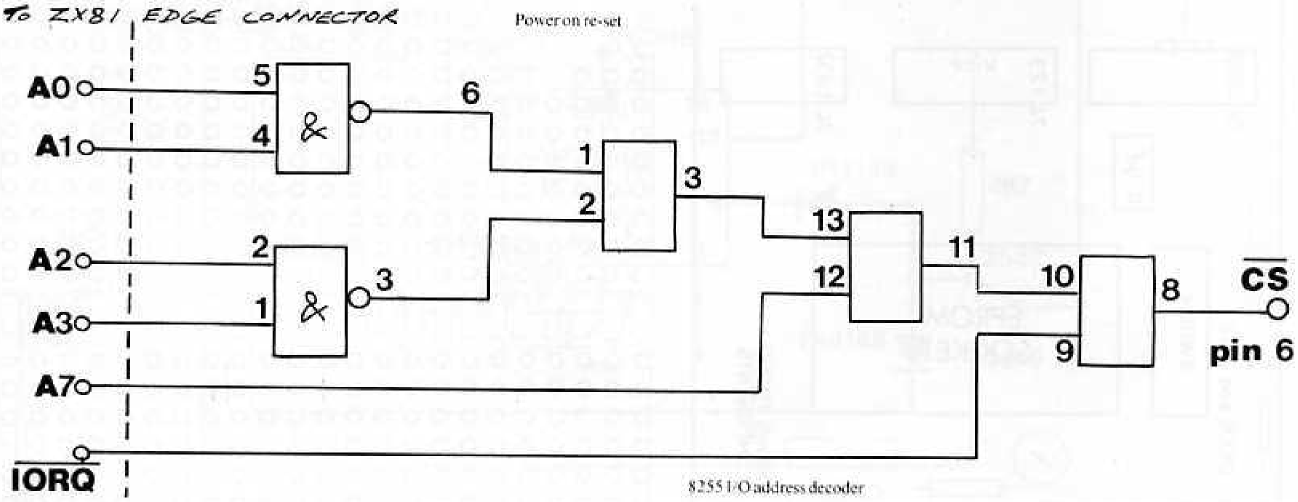


Figure 2: EPROM blower outside its case

Figure 3: P.S.U. diagram



Power on re-set



8255 I/O address decoder

EPROM BLOWER

two Nand gates have been used and three Or gates to drive the chip select pin. $\overline{CS}$ will go low only when A0, A1, A2, A3 are logic 1 and A7, $\overline{IORQ}$ are logic 0. That places the 8255 at 1FH, 3FH, 5FH, and 7FH. The other two Nand gates ensure that the 8255 and 50ms timer are re-set when power is applied.

The only difference between the 2516 and 2532 EPROMs are two pins and that is why a switch has been included. When programming the 2532, the programming voltage must be switched from 5V to 26V and back to 5V either side of the programming pulse. With the 2516 it may be left at 26V to verify the EPROM contents. The 26V regulator can be switched to 5V by the PC7 output going high, switching-on the BC108 and placing a 5V zener across the 24V zener.

The power supply is standard, using a single transformer and half-wave rectification for the 5V supply and voltage doubling for the 26V supply. It is best to make sure that the transformer you buy has two 9V windings in series aiding. The 50ms timer uses a 74123 TTL chip—only one half is being used. The diode And gate is needed as pin 20 of a 2532 needs to be low when reading (C5) and low for 50ms when programming.

The prototype is constructed on two pieces of Veroboard; the PSU on 0.15in. matrix and the main components on a piece of VQ board. It is wired with Verowire, which is ideal for a prototype, as modifications are easy to implement. The final board is

Table 1

2516, 2K by 8-bit

	EPROM function	Nothing	Read	Program
PC0	A8	—Standard	Address	Inputs—
PC1	A9	—Standard	Address	Inputs—
PC2	A10	—Standard	Address	Inputs—
PC3	Not used	—	—	—
PC4	PD/PGM	Low	Low	Pulsed high
PC5	Not used	—	—	—
PC6	CS	High	Low	High
PC7	5v/26v	High	High	Low

2352, 4K by 8-bit

	EPROM function	Nothing	Read	Program
PC0	A8	—Standard	Address	Inputs—
PC1	A9	—Standard	Address	Inputs—
PC2	A10	—Standard	Address	Inputs—
PC3	A11	—Standard	Address	Inputs—
PC4	PD/PGM	Low	Low	Pulsed high
PC5	Not used	High	Low	High
PC6	CS	—	—	—
PC7	5v/26v	High	High	Low

Figure 4: Components of small board

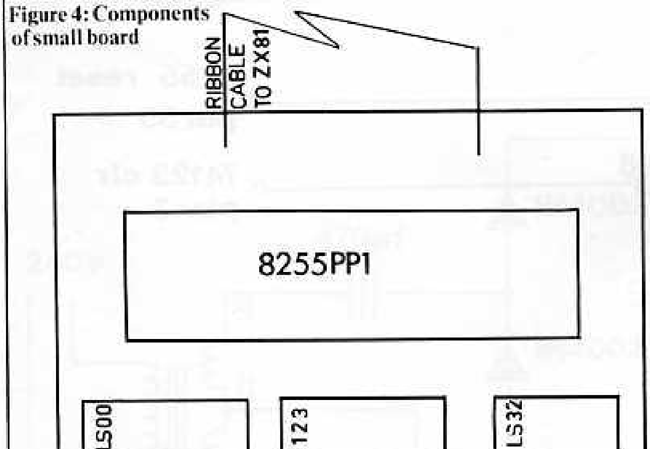
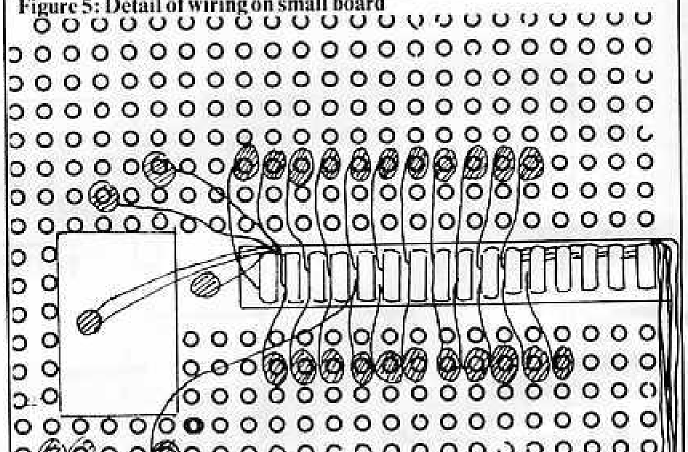
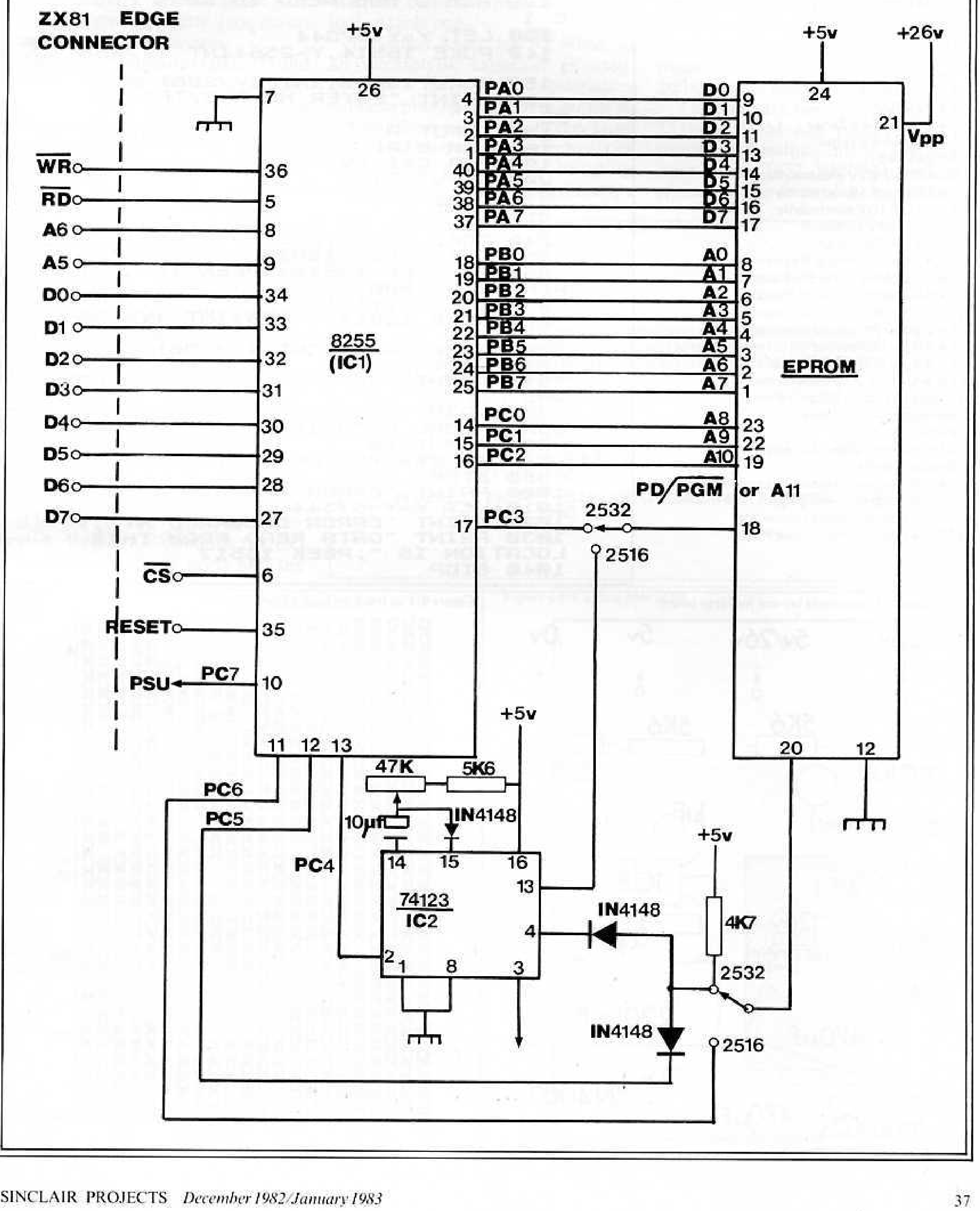


Figure 5: Detail of wiring on small board



EPROM BLOWER

Figure 6: Main circuit diagram



EPROM BLOWER

Components

1 × INS8255 (1C 1)
1 × 74132 (IC 2)
1 × 74LS32 (IC 3)
1 × 74LSOO (IC 4)
1 × 7805 (IC5) 5v 1A regulator
1 × BD235 (TR 1)
1 × BC108 (TR 2)
3 × IN 4002
1 × BZY88 24V Zener
1 × BXY88 5V zener
3 × IN4148
2 × 470 μ-F 63V electrolytic
1 × 2200 μ-F 16V electrolytic
1 × 10 μ-F 10V electrolytic
1 × 1 μ-F 63V tantalum
3 × 0.1 μ-F Polyester
1 × 47K ohms Preset Resistor
1 × 5K6 ohms 1/2w 5% Resistor
1 × 4K7 ohms 1/2w 5% Resistor
1 × 2K7 ohms 1/2w 5% Resistor
1 × 2 pole change-over switch
1 × 40 pin DIL socket
1 × 24 pin zero force socket
1 × 9-0-9V 1 amp transformer
1 × case 16cm. × 10cm. × 6cm.
Veroboard—VQ board
Verowire
12in. ribbon cable—20-way
Nuts and bolts
Cassettte-type chassis plug and free socket
Connecting wire—single plus twin mains
23-way double-edge connector
23-way double male-male PCB

```
 100 PRINT "WHAT ADDRESS IN THE
EPROM"
 110 INPUT Y
 120 REM 3 MSB NEED TO BE A LOGI
C 1
 130 LET Y=Y+57344
 140 POKE 16514,Y-256*INT (Y/256
)
 150 POKE 16515,INT (Y/256)
 160 PRINT "ENTER NO OFBYTES TO
BE SENT"
 170 INPUT A
 180 DIM B(A)
 190 FOR C=1 TO A
 200 INPUT B(C)
 210 PRINT B(C)
 220 NEXT C
 230 FOR C=1 TO A
 240 POKE 16516,B(C)
 250 LET S=USR 16518
 260 IF PEEK 16516<>PEEK 16517 T
HEN GOTO 1000
 270 LET Y=Y+1
 280 POKE 16514,Y-256*INT (Y/256
)
 290 POKE 16515,INT (Y/256)
 300 NEXT C
 310 PRINT "JOB FINISHED, NO ERR
ORS"
 320 PRINT "DO YOU REQUIRE TO PR
OGRAM MORE DATA IN"
 330 INPUT Z$
 340 IF Z$="Y" THEN GOTO 100
 350 STOP
1000 PRINT "ERROR HAS OCCURRED"
1010 LET Y=Y-57344
1020 PRINT "ERROR OCCURRED AT";Y
1030 PRINT "DATA READ FROM THIS
LOCATION IS ";PEEK 16517
1040 STOP
```

Figure 7: Component lay-out for large board

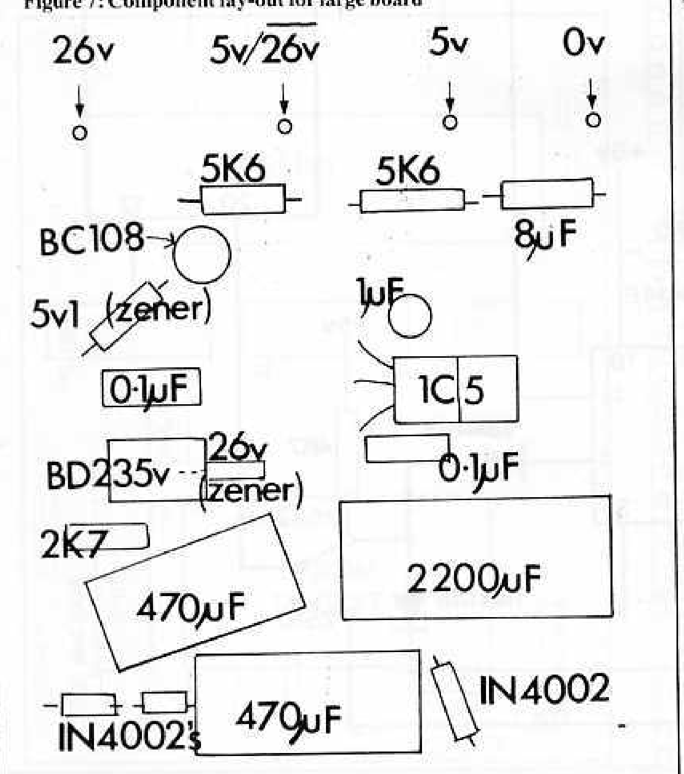
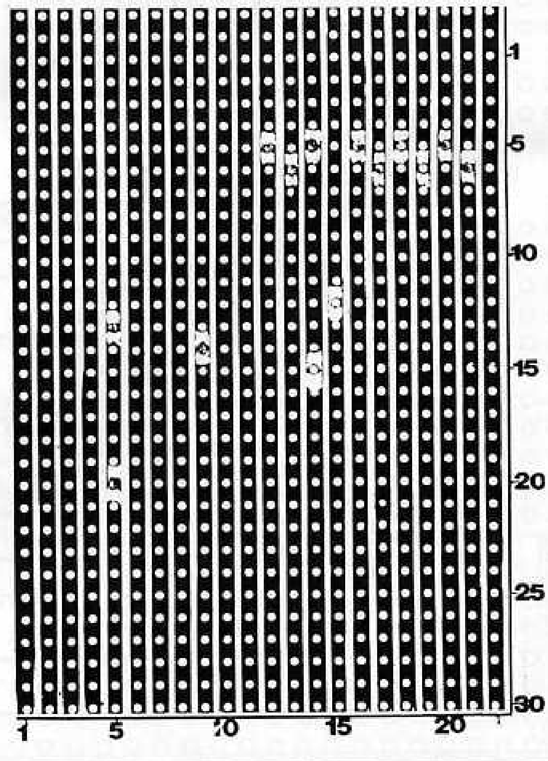


Figure 8: Cut track on back of large board



somewhat cluttered because an extra chip had to be added at a later stage to help with the decoding of the $\overline{CS}$ line. The transformer is bolted to the base of the case and a cassette-type mains plug and socket on the case.

The power transistor (BD235) and voltage regulator do not need heat-sinks as they pass fairly small currents. The two boards are fixed on top of each other, with the EPROM socket emerging through a hole in the top cover of the box. The switch is mounted next to the EPROM socket.

With a REM statement on the first line of a program, the first character is at memory location 16514 decimal. The first four locations are used to hold data for the machine code program, the machine code sub-routine starting at 16518.

16514---BYTE FOR PORT B
16515---BYTE FOR PORT C
16516---BTYE FOR PORT A
16517---READ FROM PORT A—used for verification.

Within the program, register H holds the byte for port C, and register that for port B, and register B that for port A. Register C contains the I/O location of the three ports and the Control Location. Register DE is used as a counter to pause for longer than 50ms—when following the machine code routine, it is useful to look at table one.

The timer has to last for 50ms, so an electrolytic capacitor is used. Because they have tolerances between plus 100 percent or minus 50 percent the pre-set is made very large to take account of it. If electrolytics are used, the timer should be set up on an oscilloscope. If an oscilloscope is not available, tantalum capacitors should be used instead. Alternatively, it is possible to feed the Q output temporarily to the port A input—any will do—and write a small program to measure the duration of the output pulse, time between C4 going low and Q output returning low.

The software has been tested on a 2516 EPROM and programmed a routine successfully into it. The software for a 2432 EPROM will be given in a later issue of the magazine.

```
   1 REM AAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAA
  10 LET X=16518
  20 INPUT Y
  30 PRINT X,Y
  40 POKE X,Y
  50 LET X=X+1
  60 GOTO 20

N.B. THERE SHOULD BE AT LEAST 80
  A"S IN LINE 1
```

Figure 9: Cutting tracks

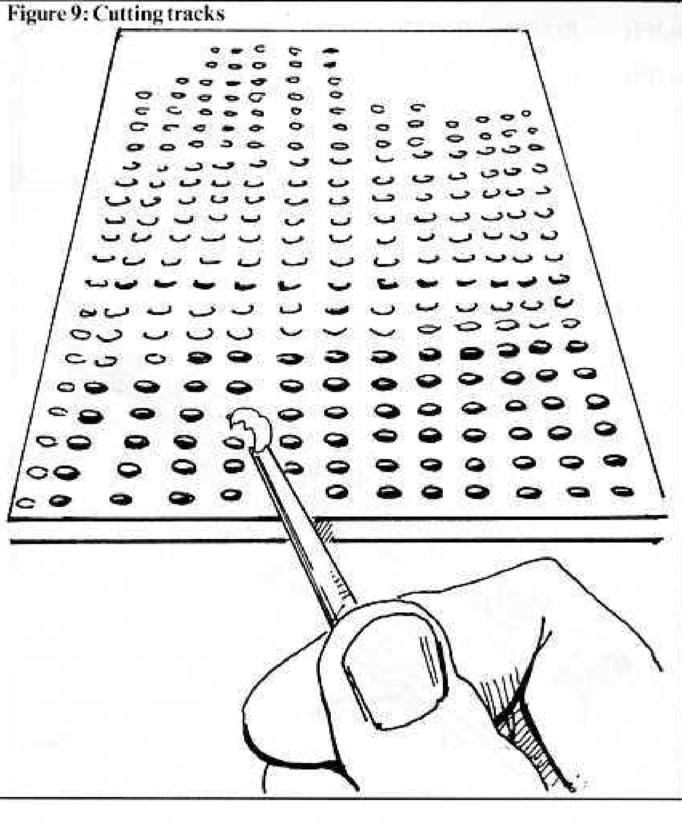
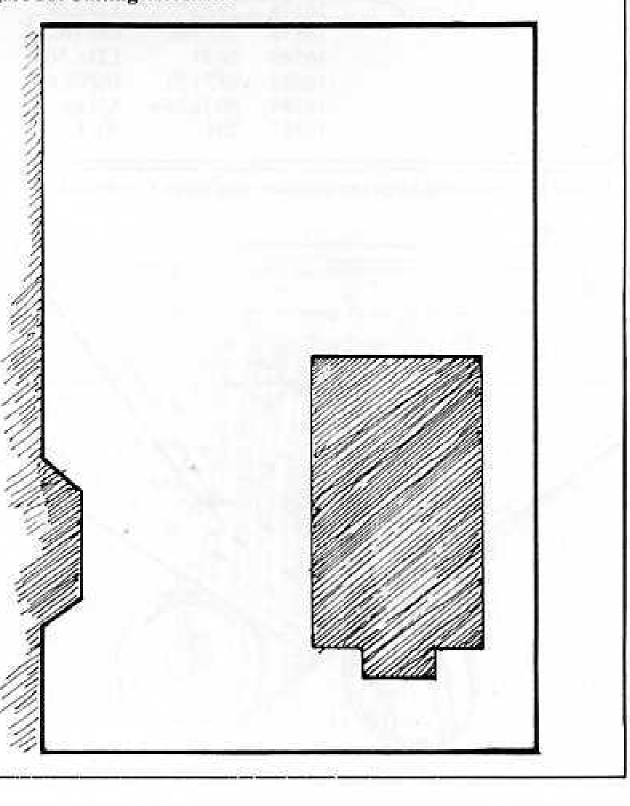


Figure 10: Cutting hole in lid



EPROM BLOWER

Machine Code Table

16514				
16516				
16518	14 127	LD r, N	r=c, N=7FH	Conditions the ports as outputs
16520	62 128	LD r, N	r=A, N=80	"
16522	237 121	OUT(C), r	r=A	"
16524	42 130 64	LD HL, (nn)	nn=16514	Sets up H, L and B.
16527	58 132 64	LD A, (nn)	nn=16516	"
16530	71	LD r, r'	r=B; r'=A	
16531	14 95	LD r, N	r=C, N=5FH	
16533	237 97	OUT(C), r	r=H	Outputs
16535	14 63	LD r, N	r=C, N=3FH	H to port C
16537	237 105	OUT(C), r	r=L	L to Port B
16539	14 31	LD r, N	r=C, N=1FH	B to Port A
16541	237 65	OUT(C), r	r=B	
06543	14 95	LD r, N	r=C, N=5FH	
16545	203 188	RES b, r	Bit 7 Low	Begins programming Cycle.
			r=H	
16547	203 228	SET b, r	Bit 4 High	
			r=H	
16549	237 97	OUT(C), r	r=H	
16551	203 164	RES b, r	Bit 4 Low	Reconditions Report C does
			r=H	
16553	237 97	OUT(C), r	r=H	not stop 74123 from working.
16555	17 00 00	LD dd, nn	dd=DE, nn=00	
16558	29	DEC m	m=E	
16559	32 253	JR NZ, e	e=-1	110ms delay.
16561	21	DEC m	m=D	
16562	32 250	JR NZ, e	e=-4	
16564	14 127	LD r, N	r=C, N=7FH	Reconditions A as I/P.
16566	62 144	LD r, N	r=A, N=90	Reconditions A as I/P.
16568	237 121	OUT(C), r	r=A	
16570	203 180	RES b, r	Bit 6 Low	Reconditions H and
			r=H	
16572	14 95	LD r, N	r=C, N=5FH	sends to Port C.
16574	237 97	OUT(C), r	r=H	
16576	14 63	LD r, N	r=C, N=3FH	Refills Port B.
16578	237 105	OUT(C), r	r=L	
16580	14 31	LD r, N	r=C, N=1FH	Read EPROM.
16582	237 120	IN(C), r	r=A	Store result at 16517.
16584	50 133 64	LD nn, A		
16587	201	RET		

Figure 11: Soldering large components onto large Veroboard

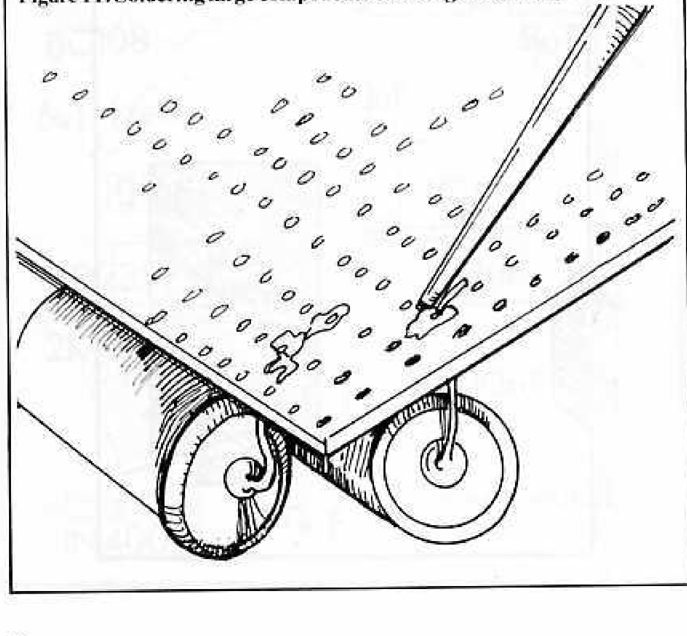
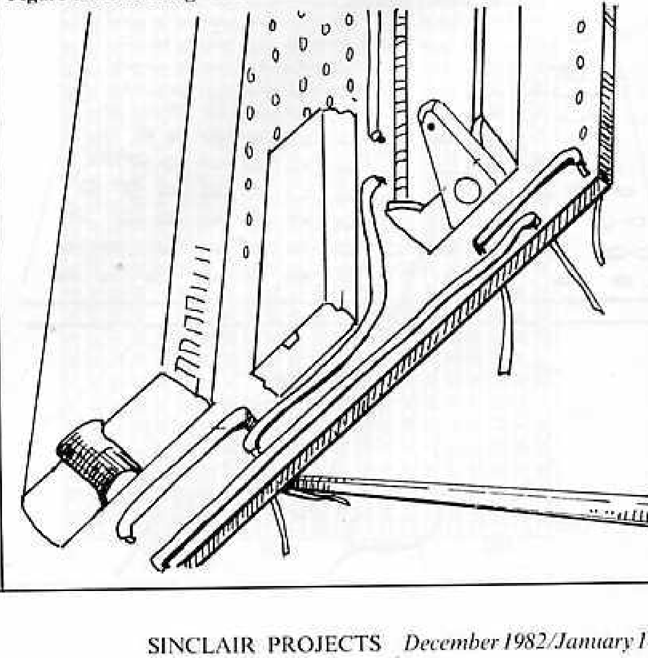


Figure 12: Soldering wires to small board



EPROM BLOWER

Figure 13: Connecting fine wires along "farmers" underneath small board

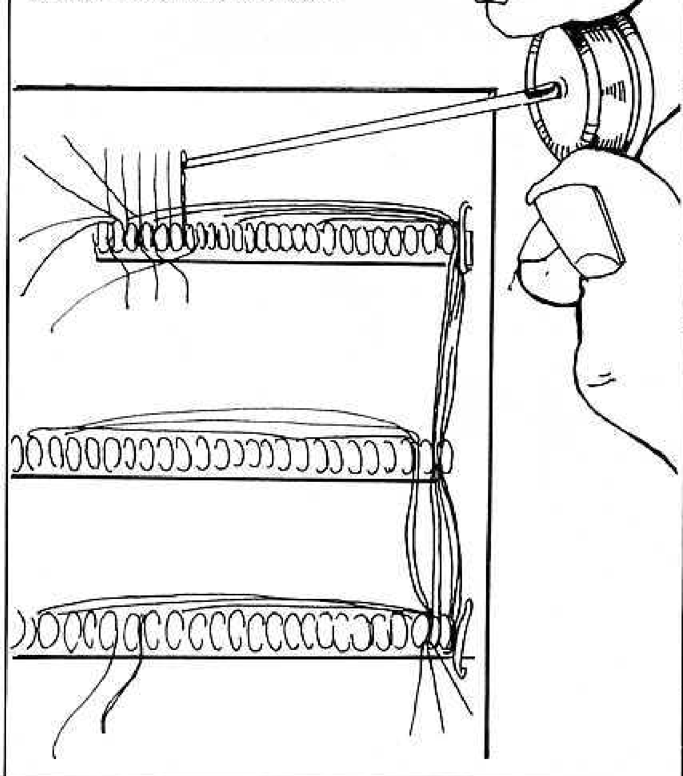


Figure 14: Connecting small board to large board

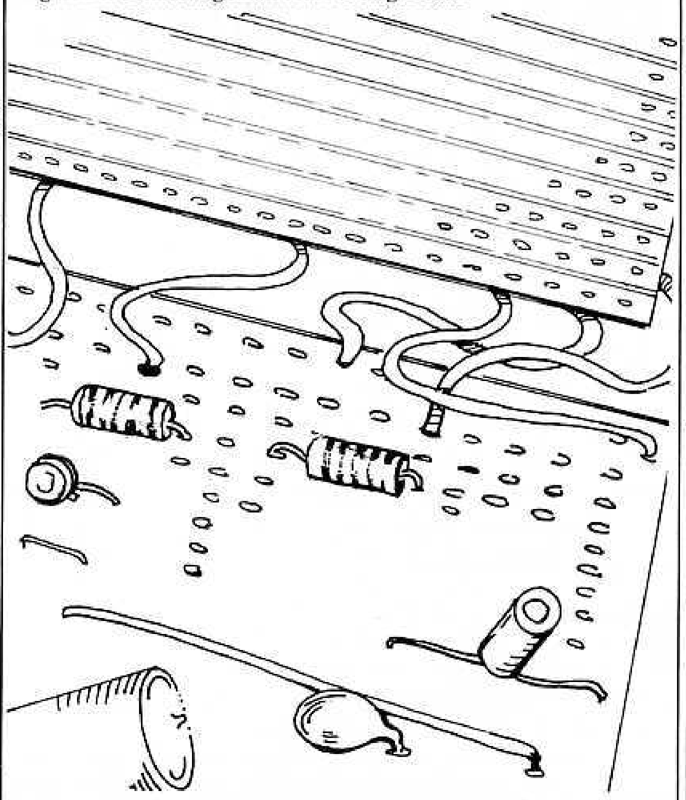


Figure 15: Attach transformer and mains socket to box

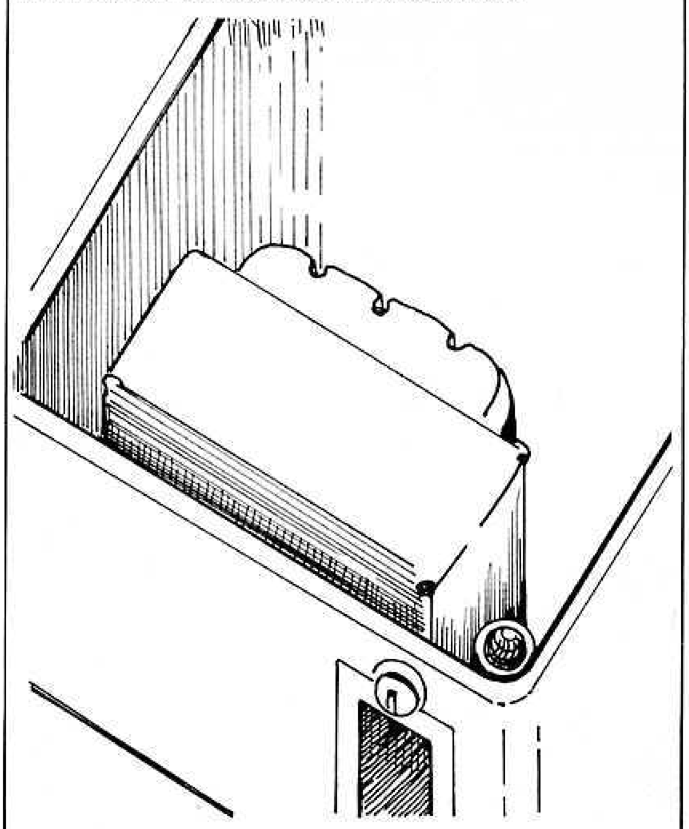
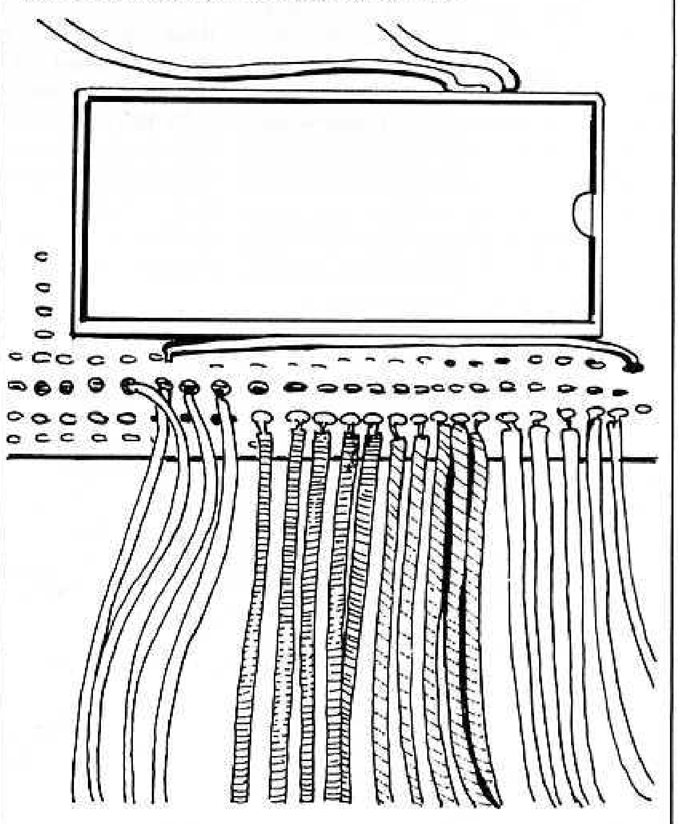
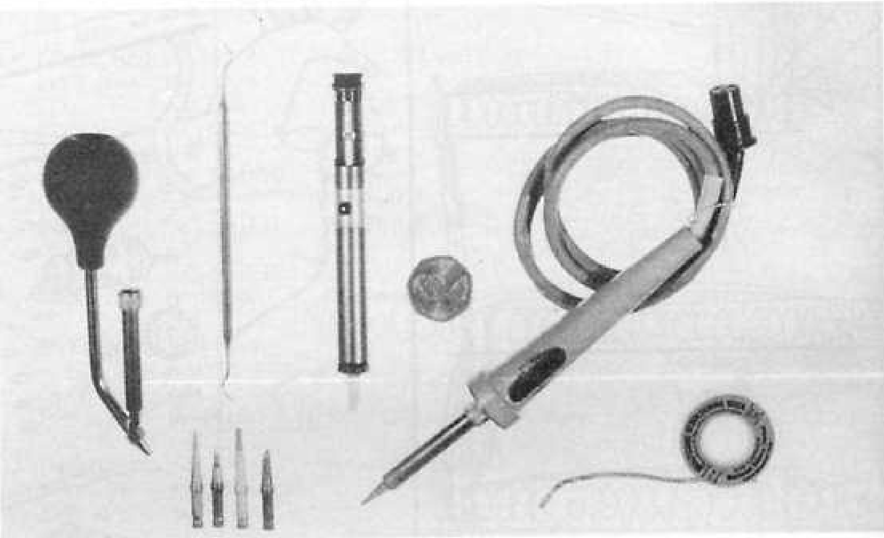


Figure 16: Connect small board to edge connector



Tooling-up for an absorbing hobby

Whatever your ambitions, a toolkit of some kind is essential. Most jobs are made easier if the correct kit is used. In this first article Richard Larkin gives some tips on the basic items which are required and looks in detail at some of the important tools.



Weller iron, spare bits, proble, aspirator attachment, braid and sucker

EVEN if your ambitions run no further than a ready-built microcomputer, you will still need a tool kit of some size.

The list of what you may need and how to choose it is not exhaustive, neither is this the minimum tool kit you must have, although here are some suggestions for a beginner's kit—a nail-file as a screwdriver, probe, knife, wire stripper and cutter, file, scraper and tommy-bar; and a cigarette lighter will melt tape solder wrapped round an emergency joint and shrink the heat-shrinkable sleeve with which you insulate it.

How do you choose a tool? If it is one you will use often, buy quality, the best you can afford. For less commonly-used items, balance frequency of use against cost.

What do you look for when shopping? Start by reading two catalogues. Visit a good tool-shop rather than an ironmonger which sells only a few tools. A reputable brand name is some help but brand names can be bought and sold. So look to see if a tool appears well-made—no rough edges, mould marks, burrs or other obvious defects; in effect, if it looks cheap and nasty. Will it stand regular use?

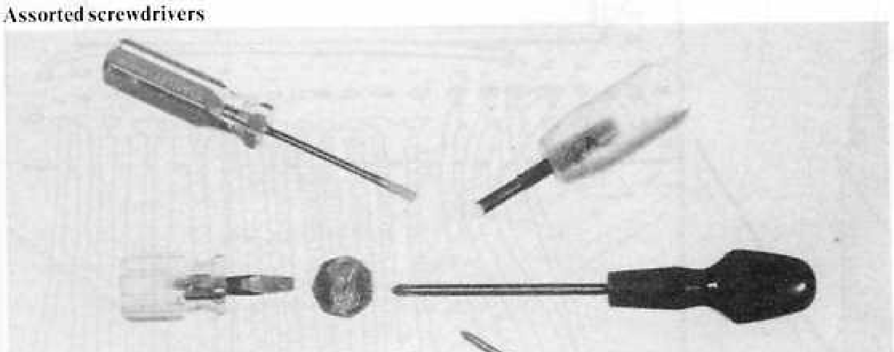
The next test is to pick it up, see how it feels, and if it fits your hand. The final test is whether you need it.

Unless you decide that you will use only wire-wrap techniques and will never modify or repair soldered equipment, you will need a good, lightweight soldering iron. The first decision is whether or not it should be temperature-controlled. Controlled irons cost more but there is less risk of 'cooking' components. Not only semiconductors are at risk; even resistors can alter in value permanently if over-heated, and copper track can be lifted from printed circuit boards. Any soldering job requires care but can be handled regardless of the type of iron.

If you choose an uncontrolled iron, buy one with a power rating of between 12 and 30 watts and, preferably, with interchangeable bits. A 1mm. or 3/64in. and a 3mm. or 1/8in. bit will suit most jobs.

For a temperature-controlled iron, choose one rated between 20 and 60 watts. It does not matter whether you choose the Curie point switching type, where you change the bit for

Assorted screwdrivers



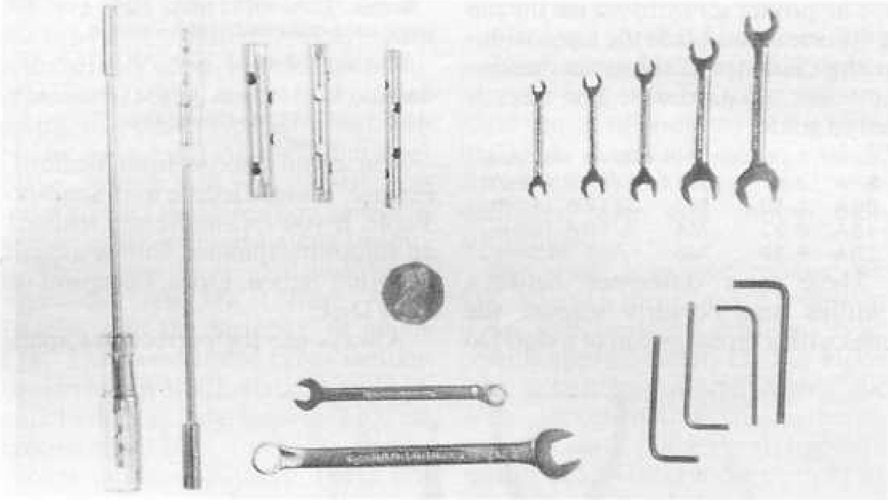
TOOL KIT

different temperatures; the fixed type, where you change both element and bit; or the continuously-variable type. Work at about 265°C (500°F) to 315°C (600°F). Some military contracts specify that work must be done with irons set no higher than 265°C.

The Antex CTC and XTC and the Ersa TE50 have built-in thermocouples and must be run from a suitable controller/power supply. An article in *Elektor* No. 41, September, 1978, contains a circuit and a printed circuit board layout. Estimated cost is approximately £9. Any other low-voltage iron requires only a basic power supply, i.e., a transformer and a fuse.

Best buys seem to be the Oryx 50, mains or low voltage, and the Weller TCP-2 with PU-2D.

Use either 60/40 solder or Savbit with a resin or other non-corrosive flux. Never use acid flux. You will probably find 22 standard wire gauge the best size and 18SWG second best.



Assorted spanners and Allen keys

What do you do when you find you have soldered something the wrong way round? The simplest de-soldering aid is the de-soldering braid. It is copper wire braid-coated in a non-corrosive flux. You place the braid on top of the joint and the hot iron on top of the braid. First the flux melts, then the solder, which is soaked-up by the braid by capillary action. The best braid would appear to be Solder-Wick. Others available are Spirig and Wik-It.

The other type of aid is the sucker. It may take the form of a sprung piston in a cylinder, or of a simple rubber bulb; both types will have a high temperature-resistant plastic nozzle, usually PTFE. In use, either compress the spring until the piston latches or squeeze the bulb. Apply the iron and the nozzle to the joint; when the solder melts, release the bulb or trigger the piston. They cost from £3 to £12.

A favourite version is the one-handed sucker, or aspirated iron. The iron has a hollow bit, connected by a tube to a rubber bulb. Squeeze the bulb, apply the bit to joint and, when the solder melts, release the bulb. That type is available as an attachment for the Weller TCP2 and WP 60D at £8.57 and as a complete unit from Adcola, the R500, at £16.18.

Always buy good-quality screwdrivers. Cheap ones bend, twist, snap or fall apart in you hand. Do not buy a set of jewellers' drivers—you will never need them. Do not buy sets; if they are of good quality, the price of a set will scare you. If they are not of good quality, they are not worth having.

TEMPERATURE-CONTROLLED IRONS—MAINS

Antex	X50TC	50W
Litesold	LE40	40W £16
		£11.50
	Adamin 12	£6 (approx)
		£16.50 (approx)
	TC50 (mains)	50W £13.80
	TC50 (24V)	50W £13.80
		£27.30 (approx)
Oryx	50	60W £13.75
Weller	WP60D	60W £18.35
	WEC240	£28
Low voltage		iron supply
Adcola	101	£59.95 complete
	333	
	KWZ4A	complete
	444	50W
Antex	CTC	30W £18.50
	XTC	50W £13.50
		£50.67
Ersa	TE50	50W £59 complete
Oryx	50 (24V version)	50W £13.75
	PSU 24	£23
Wahl	Iso-tip cordless	50W £22.25 complete
	ditto, faster recharge rate	£26.40 complete
Ungar	50TA	50W £42.28 complete (R.S.)
	24V iron	48W £26.63 (R.S.)
Weller	TCP-2	45W £14.27
	PU-2D	£23.88
	WC100	
	cordless	25W £33.18 complete

NON-CONTROLLED IRONS—MAINS

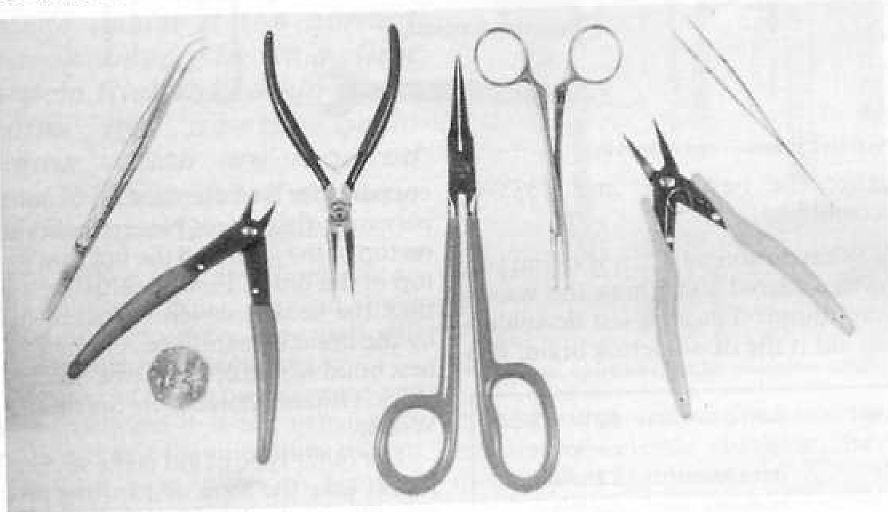
Adcola	K1000	
	K200	
	Invader	27W
Antex	CX240	17W £4.80
	CCN240	15W £4.70
	X25	25W £4.80
Oryx	Super 30	27W £5
	M3	17W £5
Ersa	Multitip 230	25W £7
Litesold	LC18	18W £6.10
	LA12	12W £5.95
Weller	Marksman series	
	S1 15D	15W £5.48
	S1 25D	25W £5.48
	WM 12D	12W £4.73

TOOL KIT

The proper screwdriver for the job is the one with a blade the same width as the diameter of the screw head—no wider, no narrower. The table is only a guide:

British	American	Metric	Driver size (app)
8BA	2.56	M2.5	1/8in. (3mm.)
6BA	4-40	M3	3/16in. (4mm.)
4BA	6-32	M4	3/16in. (5mm.)
2BA	8-32	M5	1/4 (6.5mm.)

There is a difference between Phillips and Pozidriv screws, the ones with a cross instead of a slot. Do not think it does not matter and do not listen to those who tell you so. Do not use the wrong driver on a cross-head screw. The incorrect choice can leave you with a stripped-out screw head, a damaged tool and a bloody hand. Names from which to choose include Stanley, Bahco, Xcelite and Snap-on Tools.



Various pliers, forceps and tweezers

Allen keys are in inch and metric sizes. For once, British and Americans use the same sizes—it must have been an oversight. You will not often need them, so buy them while you need them. They are so cheap it is not worth anyone's while to make bad ones.

Buy good spanners. Open jaw are the commonest, cheapest and most useful; it may be worthwhile obtaining ring spanners in the sizes you use most often. Tubular box spanners are cheap and useful. Nut drivers, which are like screwdrivers with a hexagon socket at the end of the blade, are useful but expensive. Again, consider them in the often-used sizes only.

British: 2BA, 4BA, 6BA, 8BA—you will rarely meet odd-numbered BA screws.

American: 3/6in. AF, 1/4in. AF, 5/16in. AF.

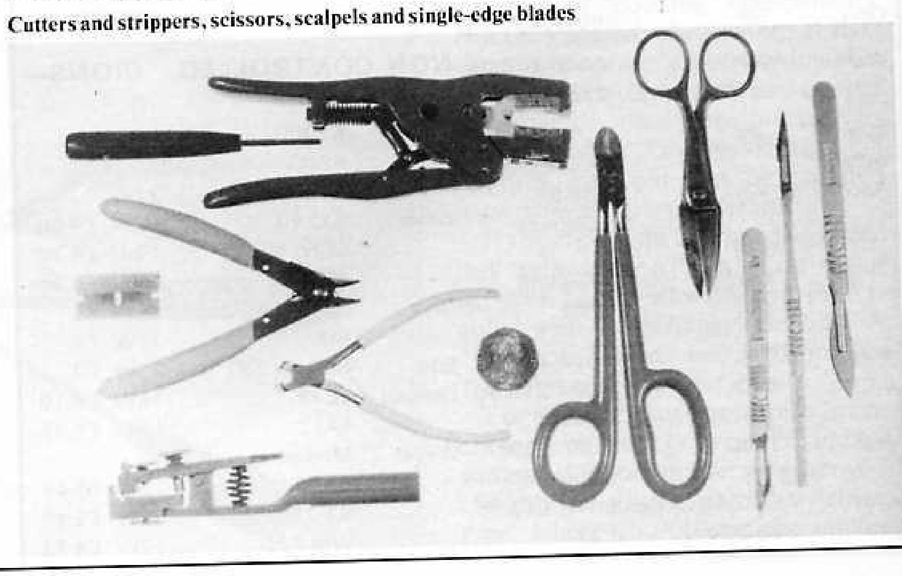
Metric: M2.5 (4.5mm. AF); M3 (5mm. AF); M4 (5.5mm. AF); M5 (7mm. AF).

You could choose from Bedford, Eclipse, Elora, Gedore and Snap-on Tools. If you feel undressed without an adjustable spanner, choose a small one from Bahco, Elora, Footprint or King Dick.

Always use the correct size spanner—do not settle for 'near enough'. The result can be rounded-off nuts.

Do not use pliers on nuts, except in emergency. If you must, use parallel-jaw pliers or quick grips, both of which were designed for the job. Grip tight or you will have round nuts and skinned knuckles.

Cutters and strippers, scissors, scalpels and single-edge blades



Fine, long-nosed pliers between 4 1/2in. and 6 1/2in.—say 11cm. to 14cm.—are the obvious choice. They may be called long-nosed, snipe-nosed, chain-nosed or simply wiring pliers. Some incorporate wire cutters, usually close to the joint, occasionally close to the tip. You will probably need separate cutters as well, so it is not an important consideration.

For heavy work, a pair of 6in. or 7in. combination pliers might be useful, or a self-grip wrench, e.g., Mole or Vise-grip. Parallel-jawed pliers are made by Maun in a range of sizes.

Choices can be made from Arhoso, Bahco, CK, Crescent, Elliot Lucas, EPE Corp, Erom, Lindström, OK, Proto, Wilkinson, Xcelite and RS Components.

Various types of tweezers are handy. Use your discretion and you will not go far wrong. Look for the types which have their legs crossed—you squeeze to open them.

Haemostatic or artery forceps are good. They have similar handles to scissors and a rachet so that they can be locked on to a job. They can be bought, substandard, from fishing tackle shops, where they are sold as disgorgers—6in. long, approx. £1.50; 9in. approx. £2.

Wire cutters are, believe it or not, precision tools. If you have to cut piano wire, or trim screws, buy the proper cutter. For general use, a small pair of side or diagonal cutters

is the best choice. An end-cutter or pincer can also be handy. For heavier work, have the Bib wire cutter and stripper.

When you look at a pair of wire cutters, open the jaws, then close them gently until they just touch. Hold them between your eyes and a bright light to see if the jaws meet all the way along. Check carefully by rotating the tool a little. Then clench the tool a little tighter—not your best, bone-creaking clench, but just a little. Look again; if the jaws do not meet properly, all the way along, leave the tool alone—it will be more trouble than it is worth.

Choices can be from the same manufacturers as for pliers but add Bib and Hellerman.

A pair of scissors with short, fat, heavy blades will be handy. Hellerman, OK, Whiteley and Wiss all make versions specially for wire cutting. Expect to pay £3.50 to £6.50.

For a tool which looks so crude, the Bib range of cutters and strippers is amazingly good. So, too, are many imitations. The only alternative seems to be the type in which the blades consist of two sets of flat steel plates, which will fan slightly and wrap around the wire. You can strip ribbon cable without having to split it. There are even single-handed versions—the AB Mk 1 from Allen Bradley and the Strippax, at about £18. The two-handed types include the Bernstein 3-805, Hellerman 1235 and Park Star Engineering T15, all costing about £9.

Now, wire-wrap tools. There are two types of wrap, regular and modified. Both consist of approximately five to seven turns of silver-plated or tinned copper wire wound on to a post which has sharp corners. The difference is that the modified wrap will have started with one-and-a-quarter turns of insulated wire on the post.

Although there is a range of wrap post sizes and of suitable wires, assume you will be using 0.6mm. (0.025in. square)—or 0.85mm. (0.035in. diagonal)—posts, and 30 American Wire Gauge (0.25mm. diameter) wire and choose tools accordingly.

For small jobs and repairs, the OK-30m is a three-in-one tool-strip, wrap and unwrap, modified type, costing approximately £6. For bigger jobs, a battery-powered wiring gun with nickel-cadium re-chargeable batteries and a charger costs approximately £35. Wire is about £1 to £1.40 per 100ft.

Names from which to choose are Gardner Denver, OK Machine and Tool (U.K.), Vector and Vero.

Every toolkit requires and eventually acquires a comprehensive if not a comprehensible complement of odds and ends. Jewellers' loupes eyeglasses or magnifiers are handy and are available in a range of focal lengths. The black thimble you wear like a monocle costs about £1 to £2.

In soldering and wiring aids, Adcola does a kit, comprising three double-ended tools—a scraper and knife, a spike and hook, and a wire brush and fork or pushing hook—for £3.95.

Do not buy, do not use and do not trust insulating tape. Cotton impregnated tape is not insulating tape. It is meant to be put over an insulated joint to protect it from mechanical damage. PVC tape is not safe. After a time, the glue softens and creeps and the tape no longer sticks firmly in place.

Instead, use synthetic rubber sleeving, e.g., Symel or Helsyn; use plastic or glass-fibre sleeving, tieing it at the ends so that it will not slip, or use heat-shrinkable sleeving.

The exception is Butapol, made by BICC. There is no glue to creep—it is pure synthetic rubber. You peel off the backing strip, stretch it, and while still stretched, wrap it on tightly. RS Components sells a self-amalgamating tape at approximately £1.50 per 10 metres reel and it is comparable.

SUGGESTIONS ON WHAT TO BUY FIRST

Tool	Approx. price	Remarks
Screwdriver, 3mm. blade 5mm. blade	60 pence 80 pence	Flat-bladed; do not bother with Pozidriv until you need it.
Small pliers	£3 up	Electronic or jewellers' size; look at the Lindström ones, to see how small they can be.
Small wire cutters	£2.70 up	e.g. from RS Components or Vero
Short, heavy scissors	£2 up	
Wire strippers	£1.60 up	Bib, or similar.
You need to decide whether you want a soldering iron or a wire wrap tool. If you are building a kit, the answer is simple—seldom is there one based on wire wrap technique.		
Soldering iron	£4 up	Choose one rated at or about 12 watts. If interchangeable bits are available, buy a fine and a medium one.
Small reel of resin-cored solder —either 60/40 or Savbit	£1 approx.	Choose 22SWG if possible. 18SWG is satisfactory but a little heavy.
Reel of de-soldering braid	£1 approx.	

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Edge Connector

ZX-81 and Spectrum Edge Connector signal allocation

SPECTRUM

BOTTOM	TOP
A_{14}	A_{15}
A_{12}	A_{13}
5v	D_7
9v	
	Slot
Ov	D_0
Ov	D_1
CK	D_2
A_0	D_6
A_1	D_5
A_2	D_3
A_3	D_4
$\overline{\text{IORQGE}}$	$\overline{\text{INT}}$
Ov	$\overline{\text{NMI}}$
Video	$\overline{\text{HALT}}$
Y	$\overline{\text{MEMREQ}}$
V	$\overline{\text{IOREQ}}$
U	$\overline{\text{RD}}$
$\overline{\text{BUSRQ}}$	$\overline{\text{WR}}$
$\overline{\text{RESET}}$	−5v
A_7	$\overline{\text{WAIT}}$
A_6	+12v
A_5	−12v
A_4	$\overline{\text{MI}}$
$\overline{\text{ROMCS}}$	$\overline{\text{RFSH}}$
$\overline{\text{BUSAK}}$	A_8
A_9	A_{10}
A_{11}	

ZX-81

BOTTOM	TOP
5v	D_7
9v	$\overline{\text{RAM CS}}$
	Slot
Ov	Do
Ov	D_1
$\overline{\varnothing}$	D_2
A_0	D_6
A_1	D_5
A_2	D_3
A_3	D_4
A_{15}	$\overline{\text{INT}}$
A_{14}	$\overline{\text{NAY}}$
A_{13}	$\overline{\text{HALT}}$
A_{12}	$\overline{\text{MREQ}}$
A_{11}	$\overline{\text{IORQ}}$
A_{10}	$\overline{\text{RD}}$
A_9	$\overline{\text{WR}}$
A_8	$\overline{\text{BUSAK}}$
A_7	$\overline{\text{WAIT}}$
A_6	$\overline{\text{BUSRQ}}$
A_5	$\overline{\text{RESET}}$
A_4	$\overline{\text{MI}}$
$\overline{\text{ROMCS}}$	$\overline{\text{RFSH}}$

Sinclair ZX Spect

16K or 48K RAM... full-size moving-key keyboard... colour and sound... high-resolution graphics...

From only £125!

First, there was the world-beating Sinclair ZX80. The first personal computer for under £100.

Then, the ZX81. With up to 16K RAM available, and the ZX Printer. Giving more power and more flexibility. Together, they've sold over 500,000 so far, to make Sinclair world leaders in personal computing. And the ZX81 remains the ideal low-cost introduction to computing.

Now there's the ZX Spectrum! With up to 48K of RAM. A full-size moving-key keyboard. Vivid colour and sound. High-resolution graphics. And a low price that's unrivalled.

Professional power – personal computer price!

The ZX Spectrum incorporates all the proven features of the ZX81. But its new 16K BASIC ROM dramatically increases your computing power.

You have access to a range of 8 colours for foreground, background and border, together with a sound generator and high-resolution graphics.

You have the facility to support separate data files.

You have a choice of storage capacities (governed by the amount of RAM). 16K of RAM (which you can uprate later to 48K of RAM) or a massive 48K of RAM.

Yet the price of the Spectrum 16K is an amazing £125! Even the popular 48K version costs only £175!

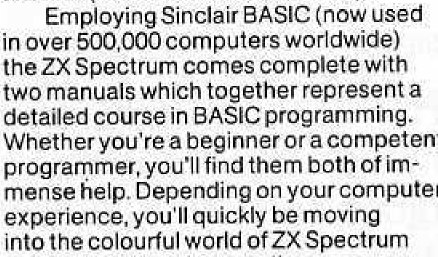
You may decide to begin with the 16K version. If so, you can still return it later for an upgrade. The cost? Around £60.

Ready to use today, easy to expand tomorrow

Your ZX Spectrum comes with a mains adaptor and all the necessary leads to connect to most cassette recorders and TVs (colour or black and white).

Employing Sinclair BASIC (now used in over 500,000 computers worldwide) the ZX Spectrum comes complete with two manuals which together represent a detailed course in BASIC programming. Whether you're a beginner or a competent programmer, you'll find them both of immense help. Depending on your computer experience, you'll quickly be moving into the colourful world of ZX Spectrum professional-level computing.

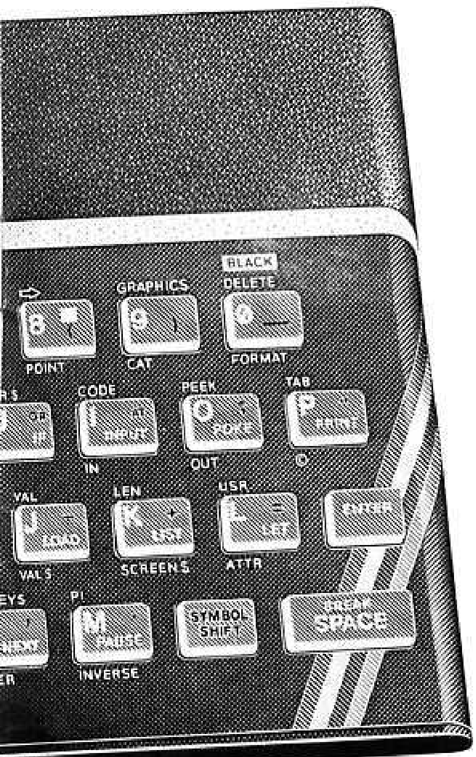
There's no need to stop there. The ZX Printer – available now – is fully compatible with the ZX Spectrum. And later this year there will be Microdrives for massive amounts of extra on-line storage, plus an RS232 / network interface board.



Key features of the Sinclair ZX Spectrum

- Full colour – 8 colours each for foreground, background and border, plus flashing and brightness-intensity control.
- Sound – BEEP command with variable pitch and duration.
- Massive RAM – 16K or 48K.
- Full-size moving-key keyboard – all keys at normal typewriter pitch, with repeat facility on each key.
- High-resolution – 256 dots horizontally x 192 vertically, each individually addressable for true high-resolution graphics.
- ASCII character set – with upper- and lower-case characters.
- Teletext-compatible – user software can generate 40 characters per line or other settings.
- High speed LOAD & SAVE – 16K in 100 seconds via cassette, with VERIFY & MERGE for programs and separate data files.
- Sinclair 16K extended BASIC – incorporating unique 'one-touch' keyword entry, syntax check, and report codes.

um



ZX Spectrum software on cassettes – available now

The first 21 software cassettes are now available directly from Sinclair. Produced by ICL and Psion, subjects include games, education, and business/household management. Galactic Invasion... Flight Simulation... Chess... History... Inventions... VU-CALC... VU-3D ...47 programs in all. There's something for everyone, and they all make full use of the Spectrum's colour, sound and graphics capabilities. You'll receive a detailed catalogue with your Spectrum.

RS232/network interface board

This interface, available later this year, will enable you to connect your ZX Spectrum to a whole host of printers, terminals and other computers.

The potential is enormous. And the astonishingly low price of only £20 is possible only because the operating systems are already designed into the ROM.

sinclair

Sinclair Research Ltd, Stanhope Road, Camberley, Surrey GU15 3PS. Tel: Camberley (0276) 685311.

The ZX Printer – available now

Designed exclusively for use with the Sinclair ZX range of computers, the printer offers ZX Spectrum owners the full ASCII character set – including lower-case characters and high-resolution graphics.

A special feature is COPY which prints out exactly what is on the whole TV screen without the need for further instructions. Printing speed is 50 characters per second, with 32 characters per line and 9 lines per vertical inch.

The ZX Printer connects to the rear of your ZX Spectrum. A roll of paper (65ft long and 4in wide) is supplied, along with full instructions. Further supplies of paper are available in packs of five rolls.

The ZX Microdrive – coming soon

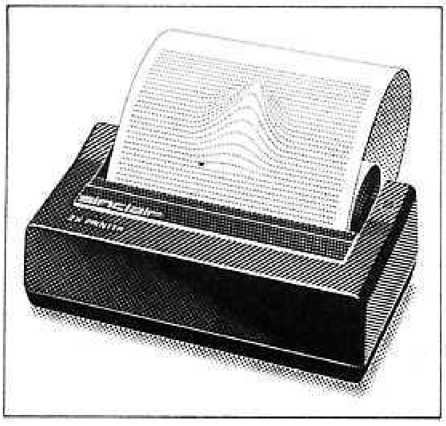
The new Microdrives, designed especially for the ZX Spectrum, are set to change the face of personal computing.

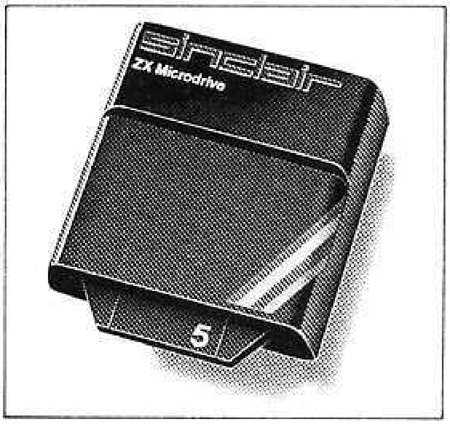
Each Microdrive is capable of holding up to 100K bytes using a single interchangeable microfloppy.

The transfer rate is 16K bytes per second, with average access time of 3.5 seconds. And you'll be able to connect up to 8 ZX Microdrives to your ZX Spectrum.

All the BASIC commands required for the Microdrives are included on the Spectrum.

A remarkable breakthrough at a remarkable price. The Microdrives are available later this year, for around £50.





How to order your ZX Spectrum

BY PHONE – Access, Barclaycard or Trustcard holders can call 01-200 0200 for personal attention 24 hours a day, every day. BY FREEPOST – use the no-stamp needed coupon below. You can pay by cheque, postal order, Access, Barclaycard or Trustcard.

EITHER WAY – please allow up to 28 days for delivery. And there's a 14-day money-back option, of course. We want you to be satisfied beyond doubt – and we have no doubt that you will be.

To: Sinclair Research, FREEPOST, Camberley, Surrey, GU15 3BR. **Order**

Qty	Item	Code	Item Price £	Total £
	Sinclair ZX Spectrum – 16K RAM version	100	125.00	
	Sinclair ZX Spectrum – 48K RAM version	101	175.00	
	Sinclair ZX Printer	27	59.95	
	Printer paper (pack of 5 rolls)	16	11.95	
	Postage and packing: orders under £100	28	2.95	
	orders over £100	29	4.95	
			Total £	

SPJ

Please tick if you require a VAT receipt ☐

*I enclose a cheque/postal order payable to Sinclair Research Ltd for £ ______

*Please charge to my Access/Barclaycard/Trustcard account no.

*Please delete/complete as applicable

Signature

PLEASE PRINT

Name: Mr/Mrs/Miss

Address

FREEPOST – no stamp needed. Prices apply to UK only. Export prices on application.

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(1) You have not received the goods or had your money returned; and

(2) You write to the Publisher of *Sinclair User* summarizing the situation not earlier than 28 days from the day you sent your order and not later than two months from that day.

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MICHAEL ORWIN'S ZX81 CASSETTES

THE BEST SOFTWARE (BY VARIOUS AUTHORS) AT LOW PRICES

QUOTES

"Michael Orwin's £5 Cassette Two is very good value. It contains 10 stolid well designed games which work, offer plenty of variety and choice, and are fun."

From the ZX Software review in
Your Computer, May '82 issue.

"I had your Invaders/React cassette . . . I was delighted with this first cassette."

P. Rubython, London NW10

"I have been intending to write to you for some days to say how much I enjoy the games on 'Cassette One' which you supplied me with earlier this month."

E.H., London SW4

". . . I previously bought your Cassette One and consider it to be good value for money!"

Richard Ross-Langley
Managing Director
Mine of Information Ltd.

CASSETTE 1
(eleven 1k programs)

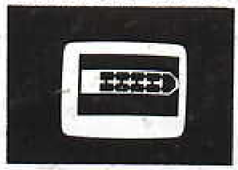
machine code:
React, Invaders, Phantom aliens, Maze of death, Planet lander, Bouncing letters, Bug splat.
Basic:
I Ching, Mastermind, Robots, Basic Hangman. PLUS Large screen versions of Invaders and Maze of Death, Ready for when you get 16k.
Cassette One costs £3.80

CASSETTE 2
Ten games in Basic for 16k ZX81

Cassette Two contains Reversi, Awari, Laser Bases, Word Mastermind, Rectangles, Crash, Roulette, Pontoon, Penny Shoot and Gun Command.
Cassette Two costs £5.

CASSETTE 3
8 programs for 16k ZX81

STARSHIP TROJAN

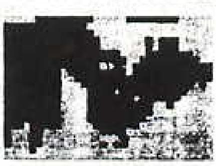


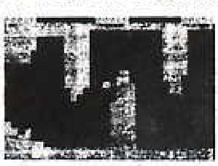
Repair your Starship before disaster strikes. Hazards include asphyxiation, radiation, escaped biological specimens and plunging into a Supernova.

STARTREK This version of the well known space adventure game features variable Klingon mobillity, and graphic photon torpedo tracking.
PRINCESS OF KRAAL An adventure game.
BATTLE Strategy game for 1 to 4 players.
KALABRIASZ World's silliest card game, full of pointless complicated rules.
CUBE Rubik Cube simulator, with lots of functions including 'Backstep'.
SECRET MESSAGES This message coding program is very txlp qexi jf.
MARTIAN CRICKET A simple but addictive game (totally unlike Earth cricket) in machine code. The speed is variable, and its top speed is very fast.
Cassette 3 costs £5.

CASSETTE 4 **8 games for 16k ZX81**

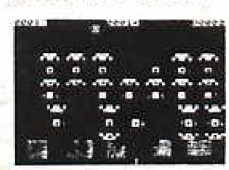
ZX-SCRAMBLE (machine code) with 3 stages.
Bomb and shoot your way through the fortified caves.

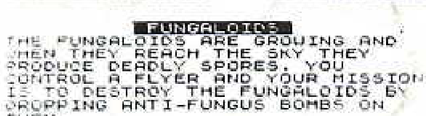


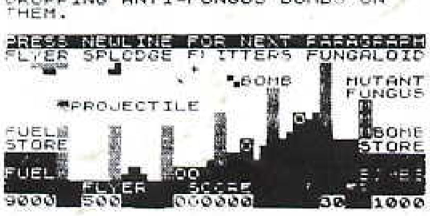


GUNFIGHT
(machine code)

INVADERS
(machine code)







GALAXY INVADERS (machine code)
Fleets of swooping and diving alien craft to fight off.
SNAKEBITE (machine code)
Eat the snake before it eats you. Variable speed. (very fast at top speed).
LIFE (machine code)
A ZX81 version of the well known game.
3D TIC-TAC-TOE (Basic)
Played on a 4 × 4 × 4 board, this is a game for the brain. it is very hard to beat the computer at it.

7 of the 8 games are in machine code, because this is much faster than Basic. (Some of these games were previously available from J. Steadman). Cassette 4 costs £5.

Recorded on quality cassettes, sent by first class post, from:
Michael Orwin, 26 Brownlow Rd., Willesden, London NW10 9QL (mail order only please)